

United States General Accounting Office

GAO

Fact Sheet for the Chairman,
Committee on Governmental Affairs
United States Senate

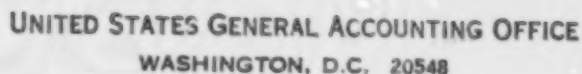
ORIGINAL

February 1986

WEAPONS ACQUISITION

Processes of Selected Foreign Governments





February 26, 1986

B-220900

The Honorable William V. Roth, Jr.
Chairman, Committee on Governmental
Affairs
United States Senate

Dear Mr. Chairman:

At your request, we have completed a study of the processes followed by France, the United Kingdom, West Germany, Israel, and the Soviet Union to acquire weapon systems.

The data on the Soviet Union was taken primarily from literary sources. We gathered information on the Soviets' defense organizational structure, system design philosophy, and military doctrine. The information we were able to obtain was not comparable to the data obtained for other countries, and therefore, we prepared a separate paper comparing the United States and the Soviet Union. (See appendix V.)

For the other countries, we obtained data on their acquisition processes and also interviewed Ministry of Defense officials, United States Embassy officials, and various experts to obtain comparable information. See appendices I through IV for detailed descriptions of the processes in each country.

FRANCE, UNITED KINGDOM, WEST GERMANY, AND ISRAEL

Acquisition agencies

The Ministries of Defense in the four countries visited have a separate directorate or agency responsible for the entire procurement function for all new weapon system acquisitions:

- France - General Directorate for Armaments.
- United Kingdom - Procurement Executive.
- West Germany - Federal Office for Military Technology and Procurement.
- Israel - Director General.

The military services in all of the countries play a role in the acquisition process. They are involved in such things as determining military requirements and participating in the test and evaluation of weaponry.

In the United States, management responsibility for defense acquisition programs is decentralized among the military services except for decisions specifically retained by the Secretary of Defense. System commands within each of the services are responsible for acquiring major weapon systems from initiation of a concept to system production.

In France, the General Directorate for Armaments is the Ministry of Defense's procurement agency. The General Directorate is responsible for all armament programs to include research, development, testing, and production, although it collaborates with the Chief of the Joint Staff and the three military services. As the directorate solely responsible for weapon system acquisition, the General Directorate monitors the public and nationalized industries involved in armaments production, and is responsible for all phases of the acquisition process.

The Procurement Executive is the United Kingdom's procurement organization responsible for acquiring new weapon systems. The procurement function is managed by three system controllerates for land, sea, and air weapon acquisitions. Project managers of the system controllerates manage the individual weapon system projects in close coordination with the military services and the Ministry of Defense.

In West Germany, the Federal Office for Military Technology and Procurement is the procurement agency responsible for acquiring new weapon systems. It is responsible for system definition, test and evaluation and procurement. These functions are managed by project managers who are part of a committee responsible for final decisions on major system acquisitions.

In the Israeli Ministry of Defense, a Director General is responsible for acquiring the major weapon systems to meet operational requirements identified by the Chief of the General Staff. The Director General is assisted by the (1) Directorate of Defense Research and Development, (2) Directorate of Production and Procurement, (3) Finance Department, and (4) Budget Department. The Directorate of Defense Research and Development generally develops the major weapon systems for the Israeli Defense Force that cannot be procured from foreign sources.

Major weapon system acquisition phases

Each country follows roughly the same general acquisition phases for its major weapon systems. These phases include (1) identifying the requirement for new weapon systems, (2) defining alternative weapon systems, (3) conducting feasibility studies, and (4) designing, developing, testing, producing, and fielding systems.

Test and evaluation

Each country conducts two major types of tests--development and operational. Development testing is done to assist the engineering design and to verify attainment of technical specifications and objectives. Operational testing is done to estimate a system's operational effectiveness and suitability, identify needed modifications, and provide information on tactics, doctrine, organization, and personnel requirements.

In the United States, development testing is normally accomplished and managed by system commands within the military services. In France, the United Kingdom, and West Germany, their centralized procurement agencies perform development test and evaluation. Israel, on the other hand, allows its military services to perform development test and evaluation.

In each United States military service, there is an operational test agency representing the user, separate and distinct from the developer. In the other countries, the following processes prevail:

- France--the Operational Directorates of the General Directorate for Armaments are responsible for the acceptance of weapon systems, although the services participate in the testing activities.
- United Kingdom--after development testing, user tests are arranged to explore the performance of the weapon system in a service environment.
- West Germany--after development testing, the contractor develops prototypes for the user trials which take place under field conditions that are intended to be as realistic as possible.
- Israel--the services are responsible for operational testing. If possible, development and operational testing are done concurrently.

Size of defense budgets

The annual defense budget in the United States is considerably larger than in the other countries studied. The approximate defense budgets for the current year were as follows:

- United States - \$300.0 billion.
- France - \$ 16.7 billion.
- United Kingdom - \$ 23.5 billion.
- West Germany - \$ 16.3 billion.
- Israel - \$ 4.0 billion.

Criteria for major weapon systems

A specific monetary level is generally used to designate a major weapon system in the United States, United Kingdom, and Israel, while France and West Germany use a more general criteria.

United States	France	United Kingdom	West Germany	Israel
R&D > \$200 million P > \$1 billion	Complex program, technical advancements, large investment	R&D > \$32.5 million P > \$65 million	Same as France	R&D > \$10 million P > \$40 million

R&D = Research and development

P = Production

> = Greater than

Defense industry

The size of the defense industrial base and the number of prime contractors capable of producing the various types of defense products is considerably larger in the United States than in the other countries, and the availability of competition varied for prime contractors:

- United States - Several prime producers for most product types.
- France - One prime producer per product type.
- United Kingdom - One prime producer per product type but 3-4 primes for missiles and tanks.
- West Germany - Two to six prime producers per product type.
- Israel - Ten prime producers.

The extent of government ownership or control over the defense industrial base varied among the countries. In the United States and West Germany, defense firms are privately owned, whereas in France, Israel, and the United Kingdom there is a mixture of state and private ownership.

Legislative oversight

In each country, the legislature exercises varying degrees of oversight over the defense budget and most major acquisition programs.

United States	France	United Kingdom	West Germany	Israel
Congress performs line item review of Defense budget	Parliament approves total budget, no line item review	Parliament approves total budget, no line item review	Parliament performs selective line item review	Knesset approves total Defense budget

In France and Israel, the legislatures generally approve the defense budgets with few significant changes. In West Germany, every contract exceeding 50 million Deutsche marks must be approved by Parliament. In contrast, in the United Kingdom, the Parliament does not have the right to change line items in the composition of the defense program.

SOVIET UNION

In many respects our super-power adversary, the Soviet Union, offers the most contrast with the United States. The Soviet Union is first of all a planned, command economy, hierarchically

organized, with a single political party. Defense needs are accorded top priority by the Communist Party and hence by the governing structure. The Party is in on every weapon acquisition decision.

Soviet technology has been denigrated by some in the West but the Soviets produce some very respectable weapon systems, often at less cost than ours. Westerners have been surprised from time to time by the Soviet speed in fielding the latest technology.

In general, the United States prefers high performance systems with their high cost and fewer numbers on the premise that quality offsets quantity. The Soviets, again in general, prefer modest technology advances, low cost, and weapons in quantity. Simplicity, standardization, and incremental improvement are often representative of Soviet design. United States engineers who have analyzed Soviet equipment conclude that vehicle by vehicle, pound for pound, Soviet equipment is similar to that of the United States. Conservatism in Soviet designs, however, tends toward stagnation and it risks block obsolescence due to Western technology breakthroughs.

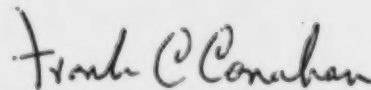
System acquisition is a disciplined risk reducing process in the Soviet Union. The Soviets build prototypes to demonstrate new systems, sometimes to compare technical approaches. Operational testing is extensive as evident in field trials and troop exercises. Small permanent design teams in charge of system design and development are an arrangement that some believe is superior to the practice of ad hoc teaming.

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Unlike in the United States, weapon system cost, schedule, and performance data was not accessible for the foreign countries surveyed. Even with this data, however, it would be difficult to compare and evaluate the efficiency of the foreign countries' acquisition processes to the United States because of fundamental political, cultural, and economic differences. There are significant variations from the United States in terms of (1) the size of the industrial base, (2) degree of legislative oversight, (3) amount of funds allocated to defense, (4) degree of government control over the industrial base, and so forth. These factors heavily influence the acquisition process; thus making it difficult to determine if the United States should adopt any of the acquisition practices of other countries.

Copies of this fact sheet are being sent to other interested congressional committees and the Secretary of Defense. Copies will be made available to others upon request.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Frank C. Conahan". The signature is written in a cursive style with a large, stylized "F" and "C".

Frank C. Conahan
Director

C o n t e n t s

APPENDIX		<u>Page</u>
I	MAJOR WEAPON SYSTEM ACQUISITION PROCESS OF FRANCE	8
	Organizational Aspects	8
	Acquisition Process	24
II	MAJOR WEAPON SYSTEM ACQUISITION PROCESS OF THE UNITED KINGDOM	32
	Organizational Aspects	32
	Acquisition Process	45
III	MAJOR WEAPON SYSTEM ACQUISITION PROCESS OF THE FEDERAL REPUBLIC OF GERMANY	50
	Organizational Aspects	50
	Acquisition Process	61
IV	MAJOR WEAPON SYSTEM ACQUISITION PROCESS OF ISRAEL	66
	Organizational Aspects	66
	Acquisition Process	72
V	SYSTEM ACQUISITION IN THE SOVIET UNION	74
	Introduction	74
	Soviet Leadership	74
	The Communist Party: The Politburo	75
	The Legislature of the Soviet Union	77
	The Government of the Soviet Union	77
	The Defense Apparatus: The Military	78
	Industrial Commission	84
	System Design Philosophy	84
	The Soviet Acquisition Process	91
	Selected Bibliography	94

ABBREVIATIONS

BWB Federal Office for Military Technology and
Procurement (Germany)

CGA Controllers General for the Armies (France)

DGA General Directorate for Armaments (France)

DM Deutsche Mark

EMA Chief of Joint Staff (France)

IDF Israeli Defense Force

MOD Minister of Defense

OMB Office of Management and Budget

R&D Research and development

SGA Secretary General for the Armies (France)

UK United Kingdom

76

MAJOR WEAPON SYSTEM ACQUISITION PROCESS
OF FRANCE

I. ORGANIZATIONAL ASPECTS

(A) Oversight and funding

--Legislature

- (1) The Parliament (Assembly and Senate) approves the total amount of funds allocated to Defense.
- (2) The Parliament generally approves defense budgets with few significant changes.

--Executive participation

- (1) The Ministry of Finance is responsible for the Budget process.
- (2) The Ministers of Finance and Defense discuss and agree on the total amount of funds allocated for Defense during the budget process.
- (3) The Minister of Finance is a member of the Defense Council which establishes, among other things, the long-range defense planning goals (15 year period).

--Budget process

- (1) The 1984-88 Defense Programming Law covering a 5-year period estimates the resources that will be made available to the Armed Forces.*

(Note: The total amount of funds (credits) allocated to Defense over the 5-year period is estimated to be 830 billion francs.* Overall, the Armed Forces purchasing power will increase by an estimated 2 percent per year.)

*As of October 1985, \$1.00 = 9 francs.

- (2) The yearly Defense budget provides the funds (credits) which will be used for investment and equipment as well as operations. Throughout the budget process, the Defense Programming Law provides a point of reference for the development of the yearly budgets.
- (3) The Minister of Defense (MOD) budget proceeds along the following steps:
 - (a) The Defense Council establishes a Defense Plan covering 15 years, which identifies the basis for the military requirements. The Defense Council consists of the President of the Republic, MOD, Minister of Finance, Minister of Home Affairs, General Directorate for Armament (DGA), Chief of the Joint Staff (EMA), and the Chief of Staff for each service.
 - (b) Initially, the MOD's Secretary General for Administration (SGA), the DGA, and the EMA review the prior year's budget to draw upon the actual experiences of the past year. At the same time, the EMA will set priorities for the funding of the weapon systems. (January through May.)

(NOTE: The EMA is responsible for planning and programming plans which are sent to the MOD. He is assisted by the DGA who understands the industrial and technical aspects, and the SGA who understands the financial aspects.

The EMA works with the service staffs to establish priorities in military requirements. These military requirements are identified through the development of the Defense Plan (15 years), Defense Program Law (5 years), and Budget (1 year). If there is a difference of opinion regarding priorities among the services, the difference of opinion is resolved by the EMA. If there is a difference of opinion between the EMA, SGA, and DGA, it is resolved by the MOD.)

- (c) The Ministers of Finance and Defense evaluate the total amount of funds available for Defense (June).

- (d) The Prime Minister, in consultation with the Ministers of Finance and Defense, decides on the total amount of funds allocated to Defense (July).
 - (e) The MOD allocates the funds to the individual services (end of July).
 - (f) The services complete their budgets based on the funds allocated by the MOD(August).
 - (g) The MOD sends the Defense budget to the Minister of Finance, who consolidates all the budgets from the other Ministries (late August to early September).
 - (h) The Parliament's Finance and Defense Committees submit detailed questions to the MOD regarding the Defense budget. The MOD provides answers to these questions (September - August).
 - (i) The MOD appears before the Finance and Defense Committees to present the Defense budget (October).
 - (j) The Parliament (Assembly and Senate) formally reviews the Defense budget (November).
 - (k) The Parliament then votes on the Defense budget (December).
 - (l) The final law is signed so that the Minister of Finance can distribute credits in January (December).
- (4) The MOD's budget is completed during a 12 month time period. (January through December.)
- (5) The MOD is generally not allowed to carry over Operating Funds (title III) from one year to the next. In a few situations, however, the MOD may approve the carry over of 10 percent of the operating funds. The Equipment Funds (title V), on the other hand, can be carried forward from one year to the next.

- (6) The Defense Programming Law (5-year period) serves as a reference for the acquisition of the weapon systems. The actual authorizations, however, are found in the yearly budget.

--Defense Budget

- (1) The MOD Budget for 1985 was about 150.2 billion francs, an increase over the Defense Budget for 1984 which was 142.1 billion francs.

(a) Operating expenses (title III) - costs of maintaining the capabilities of the armed forces.

(b) Equipment expenses (titles V and VI) - costs of modernizing the armed forces such as research expenditures.

- (2) Functional analysis of the Defense budget (150.2 billion francs):

	Oper- ation (billions	Equip- ment in	Total francs)
(a) Armed Forces			
--Nuclear Forces	5.0	24.9	29.9
--Land Forces	15.8	12.7	28.5
--Air Forces	7.6	10.6	18.2
--Naval	8.2	9.0	17.2
--Gendarmerie*	11.0	1.2	12.2
--Overseas	3.4	.9	4.3
(b) Support and maintenance			
--Research & trials	2.3	5.5	7.8
--Training units	8.3	3.3	11.6
--Personnel support	7.0	.7	7.7
--Equipment maintenance	4.9	1.0	5.9
--General management	5.1	1.8	6.9
Total	78.6	71.6	150.2

*A French military police organization.

- (3) The services received the following funds (credits) for the 1985 Defense Budget:

	<u>Percent</u>
(a) Army	26.7
(b) Air Force	21.0
(c) Headquarters staff	24.6
(d) Navy	18.4
(e) Gendarmerie	<u>9.3</u>
Total	<u>100.0</u>

(4) France has the following type of procurement expenditures:

- (a) National projects-----80 to 90 percent
- (b) Collaborative efforts---10 to 20 percent
- (c) Foreign purchases-----1 percent

(B) MOD

--The system acquisition process in France is characterized by centralization and a structure of coordination and interaction among the various MOD Directorates. Within the MOD, the following directorates are involved in the weapon system acquisition process:

- (1) The Controllers General for the Armies (CGAs), an independent controllerate staff reporting directly to the MOD, provides the financial control and oversight for armament programs and all other expenditures in the MOD.
- (2) The SGA, in addition to other responsibilities, is the MOD's liaison with the Minister of Finance. As such, the SGA advises the MOD on overall financial constraints impacting on planned weapon system acquisitions.
- (3) The DGA is responsible for all armament programs, to include research, development and production, in collaboration with the EMA and the three service Chiefs of Staff.

As the MOD Directorate solely responsible for weapon system acquisition, the DGA monitors the public and nationalized firms involved in armaments production, and is responsible for all phases of the acquisition process.

- (4) The EMA is responsible for developing defense policies and coordinating the long-term plans and weapon system requirements identified by the military services.
- (5) The military services identify the requirements for new weapon systems and are continuously involved throughout the acquisition process (see p. 8).

--Although the responsibility for weapon systems acquisition is centralized within the DGA, each of the directorates discussed above plays a role throughout the acquisition process. As a result, continuous coordination and interaction among these Directorates is maintained. Final approval authority for all major decisions rests with the MOD.

- (1) The Committee for Major Programs, chaired by the MOD, meets once each year to discuss and review the progress of major weapon systems. This Committee includes representatives from the DGA, the EMA, the service Chiefs of Staff, the SGA, and the CGA.
- (2) Other similar committees, such as the Defense Research and Studies Council and the Permanent Executive Committee are key to this continuous interaction throughout the acquisition process.
- (3) The MOD has final approval authority for all major decisions during the acquisition cycle. A DGA official said, however, that decisionmaking is generally by a committee process.

--The DGA acquires all weapon systems to include system design, research, development, and production. In addition, the DGA is responsible for conducting industrial-level repairs for each of the armed services, monitoring the French armaments industry, overseeing the export of armament and

collaborative projects with other countries, and supervising the industrial establishments owned and operated by the DGA.

- (1) To accomplish these tasks, the DGA is further divided into four functional directorates and five operational directorates.
- (2) The four functional directorates are assigned certain tasks relating to the DGA as a whole such as management of personnel, industrial affairs, international affairs, and research coordination. These include:
 - (a) Direction des Personnels et Affaires Generales--personnel matters.
 - (b) Direction des Programmes et Affaires Industrielles--industrial affairs.
 - (c) Direction des Affaires Internationales--international affairs.
 - (d) Direction des Recherches Etudes et Techniques--research.
- (3) The five operational directorates are responsible for studies, technical tests, and equipment manufacture in the fields of land, naval, aeronautical armament, missiles, electronics, and data processing. These include:
 - (a) Direction des Armements Terrestres--land systems.
 - (b) Direction des Constructions Navales--naval systems.
 - (c) Direction des Constructions Aeronautiques--air systems.
 - (d) Direction des Engins--missiles.
 - (e) Direction de l'Electronique et de l'Informatique--electronics and data processing.
- (4) The operational directorates provide the technical expertise and management during the

development, production, and testing of the individual weapon systems.

- (5) The head of the DGA, in close collaboration with the Chief of the Joint Staff and the three service Chiefs of Staff, has ultimate authority under the MOD for all armament studies, research, development, and production.

--While the DGA has primary responsibility for weapon system acquisition, the military services have a role throughout the entire process.

- (1) During the research phase, the military services are responsible for defining the specific operational requirements for new weapon systems and assisting the DGA in preparing the documentation required before the beginning of the development phase. In addition, the service Chiefs of Staff are permanent members of the Defense Research and Studies Council. This Council, headed by the MOD, reviews the results of all research projects and approves future research efforts.
- (2) During the realization phase (development and production), the military services work closely with the DGA to ensure that the systems being developed fulfill the units' operational needs. The military services validate the operational requirements for systems under development, define the operational conditions and limitations for proposed systems, organize and prepare the units for fielding, and are present during technical and operational testing. Furthermore, the service Chiefs of Staff are represented in each of the Defense review and approval committees, such as the Committee on Major Programs and the Permanent Executive Committee.
- (3) During the utilization phase, the military services have responsibility for operating and maintaining the systems with assistance from the DGA. The DGA provides spare parts and industrial level maintenance, and approves required modifications identified in conjunction with the military services.

--While specific figures for the numbers of military and civilian personnel in each of the MOD directorates were not readily available, a DGA official said that the acquisition of major weapon systems is heavily influenced by military engineers and technicians. These engineers, while not military officers per se, are professional engineers trained by the DGA technical schools. Once they have attained the level of Armament Engineer, they are granted military officer status. All key, top-level posts in the DGA are held by these professional engineers. All other civilians in the DGA are in subordinate roles and not at decisionmaking levels.

- (1) The DGA has a total personnel strength of about 73,600. Of this total, about 79 percent are civilians, 17 percent are professional engineers with military status, and 4 percent are military officers as shown below:

<u>Status</u>	<u>Percent of total</u>
Military	4
Permanent civil servants (military engineers)	17
Civilian workers	72
Civilians working under contract	<u>7</u>
Total	<u>100</u>

- (2) The DGA provides its own postgraduate training for its engineers and technicians. Its curriculum is designed to provide specific technical instruction in areas such as armaments engineering, production engineering, research, and armaments administration. Its 33 schools turn out about 400 engineers, 300 technicians, and 700 highly skilled workers each year.

--The MOD is a political appointee. Members of his personal cabinet (advisors and administrative staff) are appointed by the Minister. These positions are subject to change with changes in the administration.

--The Project Managers (translates more directly to Heads of Programs) are located in the DGA operational directorates. According to a DGA official, they perform an "orchestrating" role for the daily project activities and coordinate the numerous DGA specialists involved in the acquisition process.

- (1) The project managers generally do not have a permanent staff of specialists working directly for them. These specialists (i.e. cost estimators, contract specialists, production engineers, and other technicians) work for their specific directorates in the DGA and provide input to the individual projects. As a result, the project manager is the one individual responsible for coordinating and managing the overall project activities.
- (2) The project managers are always armament engineers and are graduates of the Ecole Polytechnique. This postgraduate school provides thorough technical training in the armaments field. Project managers generally begin their on-the-job training as civilian workers in the DGA arsenals and test centers before attaining the level of armament engineers. While the project managers develop their administrative and managerial skills through on-the-job training, the formal training for armaments engineers is almost exclusively technical training.
- (3) Project managers generally serve about 5 years on a particular project. In this capacity, they have primary responsibility for monitoring all aspects of the projects, including cost, schedule, and performance.
- (4) Generally speaking, the project managers have control and authority over the acquisition process because they can direct the specialists. However, these specialists are also responsible for other programs. If problems arise between the program manager and

specialists, the problems are resolved at the next higher level.

--Because of the close relationship between the MOD and the armaments industry, a DGA official said that contracts between government and industry are negotiated and somewhat less formal than in the United States.

- (1) Contracts are signed by the heads of the DGA operational directorates, and do not have to be signed at any higher level. For large projects, however, the contracts are reviewed by the permanent review committees and the Controller General. These reviews include an analysis of all administrative and legal aspects of the contracts.
- (2) The agreements for work in the DGA arsenals and test centers are more similar to work orders than legal documents. These agreements establish firm cost estimates, a detailed description of the work required, and appropriate technical specifications.
- (3) The contracts between the DGA and other industries (nationalized and private) are traditional contracts. Because of the close relationship between government and industry, a DGA official said that each understands the requirements of the other, and agreements are more easily reached. For about 70 to 80 percent of these contracts, a fixed price is negotiated and agreed on before work begins. For the remaining contracts, a maximum price is established on the basis of an analysis of the contractor's actual costs.
- (4) In most cases, a prime contractor is permitted to choose its subcontractors with approval by DGA. However, government-furnished components are sometimes used. The project manager is responsible for ensuring that the government-furnished material is supplied to the prime contractor on time and meets specifications.
- (5) The profit rate allowed to industry for armaments contracts depends on the type of work and the amount of risk inherent in the project. The current profit margins generally

range from about 4 to 8 percent for lump-sum contracts. For many of the risky or ill-defined projects, the DGA uses incentive clauses in the contracts to allow for sharing the profits between government and industry.

--Initial cost estimates are developed with the first design in the research phase. However, a firm initial estimate/commitment is not set until the end of the research phase. The cost estimates are continuously managed, and revised at least once each year in conjunction with the budget and programming cycles.

- (1) The cost estimates are developed by the DGA operational directorates, and are based on cost data and estimates supplied by the contractors. The DGA has final cost estimating and approval authority. These estimates are continuously reviewed by the appropriate DGA operational and functional directorates and the permanent review committees.
- (2) Any cost increases are reviewed closely by the DGA and review committees, and the reasons for cost growth must be classified into the following three areas:
 - (a) Unforeseen changes in the operational requirements or system design.
 - (b) Poor cost estimating by the DGA or the contractor.
 - (c) Unavoidable cost increases (i.e. exchange rate of French franc or unpredictable changes in labor conditions).
- (3) After completing a project, the DGA measures the contractor's actual costs and profits. This data is later used to negotiate future contracts.
- (4) The 5-year programming system allows the MOD to plan ahead and to provide significant commitment to the life of a project. As a result, the DGA can procure the necessary long-lead time components and ensure that the contractor has all the necessary tools at the start of production.

- (5) According to a DGA official, the DGA does not have a significant problem with unrealistic initial cost estimates or buy-ins. Because significant cost growth cannot be afforded in the budget programs for future years, initial cost estimates must be as accurate and realistic as possible. The 5-year programming law generally allows for inflation and other unpredictable cost increases, but does not provide for significant cost growths.

--The MOD considers research to be one of its highest priorities. During 1985, research and trials for equipment account for about 4 percent of the total MOD budget. Furthermore, research and trials make up about 8 percent of the total equipment costs. As such, the research effort is fully integrated throughout the MOD and DGA organizational structures.

- (1) Research, development and testing account for about 25 percent of the total Defense plant and equipment appropriations outlined in the 1984-88 Defense Program.

- (2) Within the MOD, the following directorates plan and manage the Defense research effort in close coordination with each other:

(a) Scientific advisor.

(b) Defense Research and Studies Council.

(c) Strategic Planning and Studies Group.

--Annual Ministerial Guidelines.

(d) DGA

--Multiannual Research and Studies Program.

--Multiannual Exploratory Development Program.

(e) Military service staffs (identify equipment requirements and are the end users of research).

(f) DGA Directorates.

--Directorate for Programs and Industrial Affairs (allocates funds for research).

--Directorate for Research and Technical Studies (has overall responsibility for managing and implementing defense research efforts).

(3) Defense research is done by the DGA, its arsenals and test centers, nationalized and private industries, and various universities and institutes. More than 60 percent of the defense research is done outside the MOD, primarily by the nationalized and private industries.

(4) For 1985, 5.5 billion francs have been allocated for equipment research. In addition to research conducted by industry, the following state-owned research establishments are used:

(a) The DGA

--Armament Documentation Center.

--Central Technical Armaments Establishment.

(b) National Space Research and Studies Office.

(c) St. Louis Institute.

(d) Armed Forces Central Health Authority.

(5) Because the French armaments industries rely very heavily on exporting their defense products, much of the defense research is funded by industry. Furthermore, when industry exports equipment that was developed using defense research funds, the contractor is required to pay appropriate royalties to the MOD.

--The decision to transition from development to production is generally initiated by the DGA in close coordination with the appropriate Chiefs of the

military services. To obtain approval to begin production, the DGA and military services must justify the decision and secure approval from the appropriate permanent review committees and chain of command.

- (1) Although configuration is frozen at the end of the development phase, there is generally some overlap between development and production. Modifications to the system design (after configuration is frozen) are generally required, but are very tightly controlled.
- (2) According to a DGA official, the 5-year programming process helps to ensure that the MOD does not begin more systems than it can afford in future years. As stated earlier, the program law provides allowances for some changes and unforeseen cost growth, but provides a relatively firm basis for future years' budgets. As a result, the MOD is required to plan future years' budgets in a constrained framework.

(C) Industrial base

--The French armaments industry contributes strongly to the implementation of a policy of national independence. Since the beginning of the 1960s, its mission has been clearly identified as follows:

- (1) Satisfy the many requirements of the armed forces.
- (2) Maintain the industrial base at the existing level.
- (3) Ensure that the armaments are at all times capable of responding to a changing threat.

--The DGA exercises a right of oversight for the entire armament sector, laying down the main orientations of armament-related industrial policy. The DGA relies on three distinct types of establishments:

- (1) State-run establishments, headed by DGA and under the direct authority of the MOD.

- (2) Nationalized industries which are completely or partially owned by the State include:

- (a) Aerospatiale
- (b) Avions Marcel Dassault Brequet Aviation
- (c) SNECMA
- (d) MATRA
- (e) Thomson-CSF
- (f) SNPE
- (g) Thomson-Brandt-Armaments
- (h) Renault Industrial Vehicles
- (i) Pechiney
- (j) Saint Gobain

- (3) Private industries are relatively small and generally support the state and nationalized industries.

--The government will normally award a major weapon systems contract to one company (prime) in each area:

- (1) Ships--DGA's four yards and three establishments.
- (2) Aircraft--Aerospatiale.
- (3) Combat aircraft--Avions Marcel Dassault.
- (4) Aircraft engines--SNECMA, Turbomeca.
- (5) Tactical missiles--MATRA (some competition still exists).
- (6) Electronics--Thomson-CSF.
- (7) Land weapon--SNPE, Thomson-Brandt-Armaments.

--In most cases, a prime contractor is permitted to choose its subcontractors with approval from the DGA.

- (1) The MOD does not allow competition at the prime contractor level.
- (2) The MOD, however, does allow competition at the subcontractor level.

--The prime contractors and subcontractors have the following responsibilities:

- (1) System design--contractors will be expected to design equipment based on technical specifications approved by the DGA.
- (2) Development--contractors will work closely with the Operational Directorates of the DGA create the major weapon systems.
- (3) Testing--generally, the DGA's Directorates, will conduct developmental and operational testing. If the contractors conduct the test, they either use the testing facilities of the DGA's Operational Directorates or their own facilities (not very frequently).
- (4) Production.

--The MOD believes in an exchange of staff between the DGA and private sector at all levels in the organization. For example, a representative from one of the Functional Directorates, DGA, will transfer to a company in the private sector for about 5-years before returning to the DGA.

II. ACQUISITION PROCESS

- (A) Definition of a weapon system: The MOD designates a major weapon system depending on (1) difficulty of the project, (2) strategic importance, (3) closeness to decision points, and (4) price. Furthermore, a weapon system can change levels at any time of its life.

<u>Level</u>	<u>Type of program</u>	<u>Dollar Value of programs (percent)</u>
Level I	Unreserved programs	40
Level II	Reserved programs	25
Level III	Major/Reserved programs	4
Level IV	Major programs	31
		<u>100</u>

(NOTE: The MOD normally evaluates and approves the major weapon systems in levels III and IV.)

Coordination and interaction: Throughout the acquisition process, various committees will evaluate the weapon system programs. These committees represent the views and expertise of each MOD directorate involved in the acquisition process.

Phases of the acquisition process: The major weapon system acquisition process consists of three separate and distinct phases. Each phase is considered to be totally independent. These phases include

- Definition - (research)
- Realization - (development and production)
- Utilization - (implementation)

(B) Definition phase

- The first phase of the project life cycle covers the period from the emergence of an idea for a project to the initial formal statement of an operational need.
- The definition phase includes preliminary studies encompassing basic research, applied research and exploratory development projects. Assigning funds to preliminary studies is a policy decision representing a commitment for the future of systems. As such, it is the responsibility of the MOD, supported by the advisory bodies whose task is to help identify priorities.

--The DGA has overall responsibility for managing and implementing defense research efforts. Its responsibilities include:

- (1) A large number of studies which are grouped into about 30 program themes. They form the basis of a 3-year program which is established by the DGA and the service staffs to include:
 - (a) Definition of the operational requirements.
 - (b) Identification of the possible solutions.
 - (c) Evaluation of the costs of the possible solutions.
- (2) A limited number of programs which are selected for exploratory development.

(C) Realization phase

--The second phase of the project life cycle covers the period from the initial formal statement of an operational requirement through development to final production.

--The initial formal statement of an operational requirement is presented in the launching file (requirements document) which is prepared by the Service Staffs and Operational Directorates of the DGA.

- (1) The EMA and the DGA must sign off on the launching file. The launching file will then be approved by the MOD.
- (2) After an operational requirement has evolved into a program, key personnel and committees will review the programs. The Committee on Major Programs will review the programs in order to classify them into various levels (levels I, II, III, and IV). This Committee meets about mid-January of each year. Members of the Committee include:

--MOD;

--Chief, Comptroller General;

--SGA;

--EMA;

--DGA;

--Chief of Service Staffs;

--Director of Financial Services; and

--Directorate of Programs and Industrial Affairs.

- (3) The level I programs are evaluated by the Chief of the individual service staff as well as the head of the participating Operational Directorate, DGA.

- (4) The level II and III programs are evaluated by the Permanent Executive Committee which meets biweekly throughout the year. The members of the Committee include:

--Directorate of Programs and Industrial Affairs;

--EMA;

--Head of Operational Directorate, DGA;

--SGA; and

--Representative of the Comptroller General.

(NOTE: The DGA will sign off on all Level II programs while the MOD signs off on all Level III programs.)

- (5) The Level IV programs are evaluated by the MOD on an as needed basis throughout the year. The MOD will approve and sign off on the Level IV programs.
- (6) Once a program is established, it will be administered at a level comparable to the importance of the program.

- (a) The Level I and II programs are administered by project officers in one of the Operational Directorates, DGA.
- (b) The Level III programs are administered by the head of programs in one of the Operational Directorates, DGA.
- (c) The Level IV programs are administered by a program head and project officer or a Steering Committee consisting of:

--DGA (Committee Chairman);

--Chief of Staff concerned with the program; and

--Operational Directorate, DGA, responsible for the program.

(NOTE: Steering Committees are currently responsible for the following level IV programs:

- 1) Nuclear submarines
- 2) Attack nuclear submarines
- 3) Medium air to ground missiles
- 4) Ground to surface missiles
- 5) Hermes
- 6) Athena S.S.B.N.
- 7) Satellite.)

--Development--Once the operational requirement (launching file) has been approved by the MOD, development begins on the weapon system.

- (1) Since the service staff and Operational Directorates, DGA, have coordinated their activities during the definition phase, the particular weapon system has been defined. Furthermore, the service staff has specifically identified the conditions under which the weapon system can be used.
- (2) Design and production facilities within the Operational Directorates will actually design some of the weapon systems. Furthermore, they will assist the nationalized and private industries in designing other weapon systems.

- (3) The testing facilities within the Operational Directorates will perform both development and operational testing. If possible, the development and operational testing are conducted concurrently.
- (4) The DGA's Operational Directorates are responsible for the acceptance of the weapon systems. Although the services are involved in the testing activities, they play a relatively minor role in the acceptance procedures.
- (5) Once the development of a weapon system has reached a certain point, the service staff and Operational Directorates, DGA, will prepare the launching file which is used to initiate production. The Chief of Staff for the service and DGA will sign off on the launching file. The launching file will then be approved by the MOD. Design is frozen and configuration control is established before acceptance.

--Production--Once the development of a weapon system has reached a certain point and the launching file has been approved by the MOD, production begins on the weapon system.

- (1) The service staff will organize its units and prepare them for the delivery of the weapon systems.
- (2) The DGA's Operational Directorates will begin production in their own establishments and/or contract the work out to the nationalized or private industries.

(D) Utilization Phase

--The weapon system is delivered to the service after production.

--The major areas of the utilization phase include:
(1) technical assistance, (2) spare parts, (3) repairs, and (4) modifications.

- The DGA's Operational Directorates work with the service staffs to provide for the support of the weapon systems.
- A Modifications Committee identifies what modifications are needed and who will pay for these modifications (i.e., state or industry).
 - (1) The Modifications Committee exists for the duration of the program. Further, the Director of the Committee can authorize the expenditures of funds and require the modifications to be made.
 - (2) During the initial delivery process, the DGA evaluates both major and minor modifications.
 - (3) During the latter phase of the weapon system's use, the service user evaluates the major and minor modifications.

(E) Cost, schedule, and performance

- The MOD did not have overall statistical information concerning the cost, schedule, and performance of its major weapon systems. Although detailed information on cost, schedule, and performance does exist, MOD officials stated that it would be very difficult to analyze and draw conclusions from this information.
- The MOD developed the following major weapon systems over the period from 1977 to 1985:
 - (1) 5.56mm calibre assault rifle.
 - (2) Milan and Hot antitank weapon systems.
 - (3) Roland ground-to-air weapon system.
 - (4) AMX 30 and derivative battle tanks.
 - (5) 155 GCT self-propelled artillery material.
 - (6) AMX 10P, AMX 10RC and derivatives.
 - (7) Advanced armored vehicles.
 - (8) 20mm twin gun (Vadar).
 - (9) Integrated army transmission network (RITA).
 - (10) Antisubmarine frigates.

- (11) Small antisubmarine warfare ships.
 - (12) Landing barge transports.
 - (13) Landing vessels.
 - (14) Conventional submarines.
 - (15) "Masurca" tactical missiles for antiaircraft defense.
 - (16) Mirage III family.
 - (17) Jaguar (in cooperation with Great Britain).
 - (18) Mirage F1: interceptor and attack aircraft.
 - (19) Transall C-160: transport aircraft.
 - (20) Atlantic: Sea surveillance and antisubmarine aircraft.
 - (21) SA 321 Super Frelon: Multipurpose helicopter.
 - (22) SA 330 Puma: Tactical helicopter (with U.K.).
 - (23) SA 341 Gazelle: utility helicopter (with U.K.).
 - (24) Alphajet.
 - (25) Super Etendard.
 - (26) Mirage 2000.
 - (27) W.G. 13 Lynx.
 - (28) A.S. 350 Ecureuil.
 - (29) Crotale missile based weapon system.
 - (30) Super 530 interception air-to-air missile.
- The MOD currently has 35 major weapon systems that are being researched, developed, and/or produced.
- (1) Research - 11
 - (2) Development - 11
 - (3) Production - 13

MAJOR WEAPON SYSTEM ACQUISITION PROCESS
OF THE UNITED KINGDOM

I. ORGANIZATIONAL ASPECTS

(A) Oversight and funding

--Legislative participation

- (1) The Parliament approves the total amount of funds allocated for defense. According to Ministry of Defense (MOD) officials, the Parliament, however, does not have the right to make detailed changes to the defense program.
- (2) The House of Commons Defense Committee investigates defense policy and program issues, such as security at defense establishments and long-term affordability of the defense program.
- (3) The Public Accounts Committee questions the propriety, economy, and efficiency of the defense expenditures. To assist the Public Accounts Committee, the National Audit Office conducts reviews (e.g., current evaluation of ship procurement).

--Executive participation

- (1) The Treasury is responsible for the funding budget of all the Ministries. It evaluates the MOD budget proposal. Treasury approval is required for weapon systems whenever development costs exceed 12.5 million pounds,* or production costs exceed 25 million pounds.
- (2) All expenditure proposals falling outside delegated powers have to be cleared with the Treasury, who also authorizes any proposals raising novel or contentious issues.
- (3) Other government departments attend the Equipment Policy Committee meetings, and their views on industrial and other implications of procurement decisions are taken into consideration.

*Note: As of October 1985, \$1.30 = 1 pound.

--Budget process

- (1) The Public Expenditure Survey System is used to determine how the total funds available are shared among various public expenditure programs (i.e., defense program). The survey covers the financial year just beginning plus 3 forward years.
- (2) The budget is presented to Parliament in cash terms, and explains its policies and plans. The MOD has its own medium and long-term programming system, known as long-term costing which consists of a defense program costed at constant price levels for the next 10 years.
- (3) The MOD budget proceeds along the following steps:
 - (a) The MOD approves "assumptions" which take account of military requirements and the resources likely to be available. (April)
 - (b) The defense staff, procurement executive, and services cost the centrally issued assumptions and relate those costs to the previous long-term costing. (September)
 - (c) The results of the costing are sent to the Office of Management and Budget (OMB). (September)
 - (d) The OMB, in consultation with the defense staff and defense scientific staff, is responsible for ensuring consistency with the assumptions and internal coherence. The views of the service departments and procurement executive are taken into account during this time. (September)

(NOTE: According to MOD officials, in the past, each of the services established its own priorities for its major weapon systems. In the future, the defense staff and OMB will establish priorities among the services.)

- (e) The MOD presents the current year's estimated defense budget to the Treasury. The Treasury officials check that the total conforms with the amount decided in the survey. (December)
 - (f) The Treasury submits the government's budget to Parliament. (March)
 - (g) The Parliament does not vote on the current year's budget until the summer. (June/July)
- (4) The MOD long-term costing is completed during a 12-month time span. (April through March of the next year)
 - (5) Once approved by the Secretary of State for Defense (April), the cost estimates are finalized and a summary of the long-term costing is passed to the Treasury. (June)

--Defense budget

- (1) The MOD budget for 1985-86 is expected to be approximately 18,000 million pounds. This represents a cash increase over 1984-85 of more than 1 billion pounds and represents real growth of about 3 percent.
- (2) Principal headings of the defense budget:

	<u>Pounds in Millions</u>
(a) Expenditure on personnel	6,271
(b) Expenditure on equipment	8,355
(c) Other expenditures	<u>3,433</u>
Total	<u>18,059</u>

	<u>Pounds in millions</u>
(3) Equipment procurement expenditure	
(a) Equipment	8,355
Associated costs	767
Total	<u>9,122</u>
(b) Sea	2,450
Land	1,847
Air	3,506
General support	1,319
Total	<u>9,122</u>
(4) Type of procurement expenditure	
	<u>Percent</u>
(a) UK (national projects)	80
(b) Collaborative projects	15
(c) Overseas purchases	5
Total	<u>100</u>

(B) MOD

--During the last 20 years, the approval for and acquisition of new weapon systems has become increasingly centralized within the MOD.

- (1) The unified MOD was created in 1964 by merging elements of the former MOD (a small coordinating department), the Admiralty, the War Office, and the Air Ministry. The objectives of establishing the unified MOD included (1) improving the central control of defense policy and (2) centralizing the formulation of weapons requirements.
- (2) In August 1971 the procurement executive was formed to centralize equipment procurement (from research through production) for all three services. This office was formed by combining the procurement activities of each of the three services into a single procurement organization responsible to the Secretary of State for Defense. This centralized procurement organization was intended to unite the procurement expertise among the individual services and institutionalize the procurement process within the MOD.

- (3) In 1981 two new Ministers of State were appointed, one responsible for the armed forces and the other for defense procurement. This structure placed greater emphasis on defense as opposed to the individual services.
 - (4) A subsequent reorganization within the MOD, effective January 1985, was initiated by the Secretary of State for Defense to further centralize defense operations.
 - (a) By removing the appropriate functions from the military services and consolidating these elements in the defense staff, the Chief of the Defense Staff is currently responsible for coordinating defense strategy, policy, and overall military priorities for resource allocation, programs, current commitments, and operations.
 - (b) As part of this reorganization, the functions of determining priorities for expenditure and controlling resource allocation were also taken out of the individual military services and centralized in OMB under the Secretary of State for Defense. The primary objective of the centralized OMB is to achieve stronger control over the MOD's corporate financial planning, the commitment of resources, and the financial and management systems.
 - (c) With these major elements removed from the military services, the service Chiefs of Staff are responsible for the fighting effectiveness, management, overall efficiency, and morale of their services.
- According to MOD officials, the acquisition of new weapon systems by the MOD is heavily influenced by the large number of civilian employees in the procurement executive, the defense staff, and the OMB.
- (1) About 90 percent of the 8,402 personnel in the procurement executive are career civil servant employees.

- (2) About 60 percent of the total defense staff and 99 percent of the OMB staff are civilian employees. In the acquisition process, the defense staff determines military priorities in the allocation of resources for weapon programs. OMB coordinates the long-term budgeting and financial management for new weapon systems.
- (3) The MOD currently has only five political appointees: The Secretary of State for Defense, two Under Secretaries, and two Defense Ministers. The remainder of the MOD personnel are military and civilian employees, as shown below.

Ministry of Defense
Forecast Headquarters Strength as of 1 April 1985

	<u>Civilian Staff</u>	<u>Military Staff</u>	<u>Total</u>
Centre staff:			
Defense staff	1,114	768	1,882
OMB	7,295	15	7,310
Miscellaneous	<u>262</u>	<u>34</u>	<u>296</u>
Subtotal	<u>8,671</u>	<u>817</u>	<u>9,488</u>
Navy	1,140	387	1,527
Army	1,281	842	2,123
Air Force	807	736	1,543
Procurement executive	<u>7,560</u>	<u>842</u>	<u>8,402</u>
Total	<u>19,459</u>	<u>3,624</u>	<u>23,083</u>

--The procurement executive is responsible for the weapon systems acquisition process.

- (1) Within the procurement executive, the three systems controllerates are responsible for procuring equipment for each of the land, sea, and air environments. The project directors, project managers, and project teams within these controllerates procure all the equipment (from research through production) for all three military services.

- (2) The requirements for new equipment, long-term priorities, and affordability of the projects are determined by the defense staff in conjunction with service Chiefs of Staff, the OMB, and the procurement executive.

--MOD officials said that coordination and interaction is continuously maintained between the MOD and the service Chiefs of Staff.

- (1) The service Chiefs of Staff have direct access to the Chief of the Defense Staff, and through him, to the Secretary of State for Defense on matters related to employment of his service and its current and future effectiveness.
- (2) The appropriate service Chief(s) of Staff participated in the Equipment Policy Committee which ensures that the user's needs are being properly considered during the acquisition process.

--Although the individual services provide input to the defense staff for key decisions and reviews during the acquisition process, MOD officials said that the military services have a limited role in the acquisition process.

- (1) The requirements for new equipment and the priority of those requirements are developed by the defense staff. However, the military services are frequently asked to provide input to the staff on requirements during the equipment design phase.
- (2) The military services also play a role in the testing of new equipment. These tests are intended to ensure that the equipment meets user's needs.

--The project managers, located within the three system controllerates in the procurement executive, are responsible for the acquisition of weapon systems from project initiation through production. The project manager has technical and financial specialists directly accountable to him, and is advised by the contracting officer, a member of the project team. MOD officials said that:

- (1) Many of the MOD project managers are civilians. Furthermore, the project managers are physically separated from the service staffs.

- (2) Although a project manager generally has his own team of specialists, he is required to rely on input from various other sources, including the defense staff and the contractors.

--The contracting officers develop contracts for the development and production of weapon systems.

- (1) During the past 2 or 3 years, the MOD has placed increased emphasis on the importance of obtaining competitive bids/contracts for projects whenever possible. The objective of this emphasis on competition is to ensure that the MOD is getting the most value for its investments.
- (2) In the event that noncompetitive/sole-source contracts are inevitable, the MOD requires that an incentive-type contract be used whenever possible. Generally, the preferred type of contract in this case is a fixed or maximum price. Where the conditions do not exist for such forms of pricing (for example, when there is insufficient information available, or the uncertainties of development or manufacture are too great for the fixing of fair and reasonable prices), alternative methods of pricing are employed. These include target cost/incentive fee arrangements, whereby cost overruns or underruns are shared in agreed proportions between the MOD and the contractors. Only as a measure of last resort does the MOD agree to pay contractors their costs (as reasonably incurred) plus a percentage for profit.
- (3) When a noncompetitive/sole-source contract is used, the rate of profit is subject to the government profit formula. Under this formula, the target profit rates (one for risk work where contractors could incur a financial loss on the contract, and the other for nonrisk work) are recommended by an independent review board for government contracts. The basis of these recommendations is "comparability" with the rate of return earned by analogous companies in industry as a whole.

The profit rates for individual contractors vary, as the rates are dependent to some extent on the costs of production/capital employed ratios of each of these contractors, but the overall average target returns on noncompetitive defense procurement are of the order of 6 percent on cost for risk work and 4.5 percent on cost for nonrisk work.

- (4) Under conditions included in noncompetitive/sole-source risk contracts, the MOD has the right to establish the actual costs incurred on the contract. Apart from assisting the MOD in the pricing of follow-on contracts for the same or similar items, post costing provides an opportunity for an adjustment to the price of the contract, at the request of either the MOD or the contractor, if it is found to have been priced on the basis of materially inaccurate or misleading information. Significant disputes can be referred to a review board for adjudication. This arrangement does not, of course, prevent a contractor from achieving a higher return than the intended rate if the contractor is able to perform the work at a higher level of efficiency (and therefore at a lower cost) than that reasonably assumed at the time the price was fixed. Similarly, it does not prevent a contractor from making a lower return if the work is performed less efficiently than expected.
 - (5) The MOD generally prefers not to use government-furnished components, and to require that the prime contractor acquire all subsystems through subcontracts or direct purchase. As a result, the MOD can hold the prime contractor responsible for performance of the total system.
 - (6) Full-scale prototypes are preferred whenever possible, and are more frequently used during the development of aircraft and some land systems.
- Through the use of a 10-year long-term costing process incorporated into the annual budget process, the MOD stresses the affordability of planned projects and their effect on the total defense budget. If projects are added to the long-term

plan or if the costs of a specific project increase, other projects must either be canceled or reduced so that the total defense program remains affordable.

- (1) Initial cost estimates for the early phases of system design are developed for each individual phase of the system acquisition process. Only after the project fulfills the requirements of its current design phase, and is approved to enter the next phase, is funding provided. The cost estimates are developed by finance and cost specialists in the procurement executive with significant input from the defense staff and the OMB in the form of the staff targets, staff requirements, and feasibility studies.
 - (2) The cost estimates for the development and production phases are generally provided by the contractors. Although the contractors may often submit low estimates initially, every effort is made by the technical cost staff in the procurement executive to spot low estimates and make realistic adjustments. According to MOD officials, the drive towards competition and tighter contractual conditions should result in the submission of more realistic estimates.
 - (3) Project budgets include a contingency allowance for the underestimation of the work involved and for modifications. As explained above, cost growth is tightly controlled because any growth in one project may be offset by an equal cut to another project.
 - (4) Although Parliamentary authorization of expenditure is limited to the cash outlays in the next fiscal year, contractual commitments may and do extend beyond 1 year. The funding or forward commitments to individual projects is not constrained by the Parliamentary process. However, forward commitment is kept under control, for example, by splitting orders into batches.
- Although the MOD relies on both public and private (R&D) groups to design future weapon systems, the MOD is transferring much of its public R&D to the private sector.
- (1) During the period 1971 to 1985, the MOD has decreased its public research work force in the

procurement executive from about 34,000 to about 23,000.

- (2) Public R&D planned for 1985-86 is 651 million pounds. The public research is generally performed by the following establishments:
 - (a) Royal Aircraft Establishment.
 - (b) Royal Armament R&D Establishment.
 - (c) Admiralty Research Establishment.
 - (d) Chemical Defense Establishment.
 - (e) Royal Signals and Radar Establishment.
 - (f) Atomic Weapons Research Establishment.
 - (g) Aeroplane and Armament Experimental Establishment.
- (3) Private R&D planned for 1985-86 is 1,777 million pounds. The private R&D is generally performed by the following groups:
 - (a) Private industry and public corporations.
 - (b) Educational establishments.
- (4) Whenever possible, the MOD public R&D establishments are used by other government departments and industry on a reimbursable basis.

--According to MOD officials, a system transitions from development to production only after the developed equipment is proven to satisfy the user's requirements as expressed in the development specifications.

- (1) During full development, various testing procedures are used to ensure that the system meets design standards, performance, reliability, maintainability, environmental, and other requirements.
- (2) In order to provide for smooth transitioning, there is generally some overlap/concurrency of development and production.
- (3) If at any time during development or production a system experiences real cost growth greater

than 20 percent, approvals from the equipment Policy Committee and Ministers must be obtained for the system to continue through the acquisition process. Furthermore, the Secretary of State for Defense must approve all major projects as they enter production.

(C) Industrial base

--The government's policy is that better value can be obtained from the private sector through more extensive and effective competition in the supply of defense equipment.

- (1) Direct quality assurance oversight of contractors has been reduced.
- (2) Design and development work is now being done by industry.
- (3) Performance specifications are used to state equipment needs, thus permitting industry to contribute more.

--The government believes that only certain essential activities need to be retained within the public sector and public companies are being transferred to the private sector.

- (1) Government organizations--Royal dockyards (possibly under agency management).
- (2) Public companies--wholly or partially owned by the government
 - (a) British shipbuilders.
 - (b) Rolls Royce Ltd.
 - (c) Short Bros. Ltd.
 - (d) Royal Ordnance Factories (tanks, guns, armaments, and rockets).

--According to a MOD official, the government will normally award a major weapon systems contract to 1 of 11 companies (primes).

- (1) Ships
--British Shipbuilders subsidiaries
 - (2) Aircraft
--British Aerospace (Aircraft)
 - (3) Aircraft engines
--Rolls Royce Ltd.
 - (4) Helicopters
--Westland
 - (5) Missiles
--British Aerospace (Dynamics)
--Hunting Assoc. Industries
--Short Bros. Ltd.
 - (6) Tanks (etc.)
--Royal Ordnance Factories
--United Scientific Holdings
--Guest, Keen, and Nettlefold
--Vickers
- According to a MOD official, the prime contractors will select the subcontractors to help build the major weapon system.
- (1) A large number of subcontractors are available to assist the prime contractor.
 - (2) The government attempts to ensure competition at the subcontractor level.
- According to a MOD official, the prime contractors and subcontractors share the following responsibilities.
- (1) System design--contractors will be expected to design equipment based on performance specifications.
 - (2) Development--contractors will work closely with the procurement executive to create the major weapon system.
 - (3) Testing--contractors will provide for developmental and operational test and evaluation.
 - (4) Production--contractors will provide for quality assurance during production.

- According to a MOD official, the government intends to develop interchanges of staff at various levels with the private sector.

II. ACQUISITION PROCESS

Category A = R&D greater than \$65 million and procurement greater than \$130 million.

Category B = R&D greater than \$32.5 million and procurement greater than \$65 million.

Category C = R&D less than \$32.5 million and procurement less than \$65 million.

(NOTE: Converted to dollars (\$1.30=1 pound) because information was used for comparative purposes.

(A) Concept formulation

- The first phase of the project life cycle covers the period from the emergence of an idea for a project to the initial formal statement of an operational need.
- Ideas for new equipment projects emerge from an exchange of views between the user, defense scientific staff, the procurement executive (R&D), and industry.
- During concept formulation, the procurement executive's R&D establishments, and systems controllers, in association with industry, work closely with the defense staff's operational requirements staff and user.
- The defense staff's operational requirements staff will initiate the preparation of the staff target which is the formal statement of the operational need for the equipment.

(NOTE: In the past, the military services prepared the staff targets which started the acquisition process.)

- The Equipment Policy Committee will evaluate all staff targets which fall in category A. The Equipment Policy Subcommittee will evaluate all staff targets which fall in category B.

(B) Feasibility study

- The prime aims of the feasibility study are to establish technical feasibility, cost, duration, risk, and demand on resources.
- While the defense staff prepares the staff target, the procurement executive (systems controllerates) undertake initial planning for the feasibility study.
- Work done in the feasibility phase may be confined to paper assessments and evaluation, but engineering and experimental work is sometimes necessary if the identification of a technical problem or validation of a basic concept is required.
- Feasibility studies may be undertaken in R&D establishments.
- The output of the feasibility study is a report setting out basic information on the equipment.
- The defense staff's operational requirements staff, in concert with the procurement executive, will prepare a staff requirement and the detailed plans for the project definition phase.

(C) Project definition

- The project definition phase verifies scientific and technical approaches, including identification of high risk areas and problems in developing equipment to meet the staff requirement.
- Project definition is normally under the direction and control of the project manager who may delegate authority for day-to-day management to an R&D establishment.

(NOTE: A contractor will also normally undertake future development and initial production.)
- Project definition establishes the main engineering features of the requirement, explores areas of high risk, and generates outline specification and planning documentation in sufficient detail to enable a decision to proceed.
- Project definition also places emphasis on undertaking substantial detailed design and preliminary

engineering work, including the construction of models, prototype subsystems, and component testing. The output of this phase is the project definition report which controls comprehensive technical, time, cost and resources, and management plans for full development, and outlines plans for subsequent production and in-service support.

- The choice of contractor must be established.
- The defense staff's operational requirements staff will revise the staff requirement to reflect the enhanced information gained during project definition.
- The Equipment Policy Committee will evaluate all staff requirements which fall in category A. The Equipment Policy Subcommittee will evaluate all staff requirements which fall in category B.
- The Ministers will approve the categories A and B equipment projects before full development starts.

(A go/no go decision is made at this point.)

(D) Full development.

- The full development of a project involves the engineering processes and tests to establish the detailed final design of equipment. This may include manufacture of models, prototypes, and, in some cases, preproduction versions.
- The specification of acceptance criteria is drawn up by the project manager in consultation with the user, the R&D establishment and industry.
- The project management team must ensure that the tests are precisely defined.
- Tests may be carried out by the R&D establishments, tests agencies, quality assurance directorates, contractors, and users. They are conducted to obtain data to demonstrate that performance and safety objectives have been met.
- User trials are arranged to explore the performance of the project in a service environment and are initiated by the individual service staffs in accordance with the trials plans.

(Configuration control is frozen at this point.)

- If problems occur during development, the Equipment Policy Committee and Ministers are advised. The equipment must meet predetermined cost and time schedules. If a threshold is breached, the particular project must be reassessed.

(E) Production

- Planning for the production phase is a key part of the project definition and development phases. This is essential to ensure a smooth transition from development to production, and to ensure the final product is suitable for service use and designed to be manufactured.
- In many cases, it is necessary to commence manufacture during the latter stages of the development phase. This overlapping involves risks that must be quantified and their implications assessed.
- In most cases, the ordering of long-lead materials and tooling for production must be undertaken in parallel with development.
- Early production commitments are usually made on a stage-by-stage release basis so that risk is minimized, in accordance with the principles followed throughout the project life cycle.

(F) In-service

- This phase takes place when the equipment is formally pronounced acceptable for service use.
- In some cases, it may be necessary to continue development if there are initial performance or role limitations.
- Post design services may be needed to remedy deficiencies found by the users or provide for minor enhancements. Post design services will not be used to embrace any major redesign.
- In-service support such as training aids, spares, and so forth, must be provided.

(G) Disposal

--The final phase of the project cycle is to dispose of equipment which has reached the end of its useful life. It is the responsibility of the user authorities with advice from the procurement executive to decide the timing of disposal of obsolete or surplus equipment.

(H) Cost, schedule, and performance

--The MOD did not have information readily available on the cost, schedule, and performance of its weapon systems.

For calendar year 1983, the MOD had the following categories A, B, and C equipment projects:

Number and Value of Equipment Projects

<u>Type of project</u>	<u>Number of projects</u>	<u>Percent</u>	<u>Pound value</u>	<u>Percent</u>
			(millions)	
Category A	116	7.2	26,674	64.9
Category B	122	7.6	5,975	14.6
Category C	<u>1,369</u>	<u>85.2</u>	<u>8,437</u>	<u>20.5</u>
Total	<u>1,607</u>	<u>100.0</u>	<u>41,086</u>	<u>100.0</u>

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MAJOR WEAPON SYSTEM ACQUISITION PROCESS
OF THE FEDERAL REPUBLIC OF GERMANY

I. ORGANIZATIONAL ASPECTS

(A) Oversight and funding

--Legislative participation

- (1) The Parliament is informed about armament planning at least once every year on the basis of the Bundeswehr Plan.¹ This enables Parliament to review the individual projects in context and to satisfy itself on their financial feasibility.
- (2) Parliament exercises control by its deliberation and approval of the defense budget estimates. In this process, the Minister of Defense (MOD) must justify that the projects serve the intended purpose both technologically and operationally, and are at the same time cost effective.
 - (a) The Parliament's Defense and Budget Committees evaluate equipment requirements of the federal armed forces and the expediency of the planned measures.
 - (b) The Defense Committee performs a detailed evaluation of the MOD budget.
 - (c) The Budget Committee also performs a detailed review of the defense budget. The Budget Committee is authorized to freeze funds or to make their release contingent on the fulfillment of certain conditions.
 - (d) Approval by the Parliament is the rule, not the exception.
- (3) Even after budget approval, Parliament continues to be involved in the realization of

¹The Bundeswehr Plan specifies such things as the weapon systems that will be developed by the Ministry of Defense. It is used as the basis to prepare the annual budget.

defense procurement and development projects. The Committees are informed of all major projects that are of significance for security or military policy. Furthermore, all armament contracts with a value exceeding 50 million deutsche marks (DM)* have to be submitted to Parliament for approval before contract award.

- (4) From the planning stage to the fielding of equipment, armament projects are subject to continuous parliamentary control.

--Executive participation

- (1) The Ministry of Finance poses questions dealing with the technological, financial, and economic feasibility of development and procurement projects. However, greater emphasis is placed on the financial aspects related to individual projects.
- (2) The MOD's budget division will support the budget estimates covering development and procurement in its dealings with the Ministry of Finance. As a result of these negotiations, reductions are normally made from the original budget estimates.
- (3) If questions cannot be resolved at lower levels regarding the development and procurement projects, they are resolved in top-level discussions between the Minister of Finance and MOD.
- (4) Based on the above negotiations, the budget estimates and annual finance plan are finalized for the various procurement and development projects. The projects to be acquired are shown with the
 - (a) specifications of the equipment,
 - (b) quantities of equipment,
 - (c) total costs, and
 - (d) distribution of costs over several years.

*Note: As of October 1985, \$1.00 = 3 Deutsche marks.

- (5) The cabinet approves the overall draft budget (including the MOD budget) before it is forwarded to the Parliament.

--Budget process

- (1) The basis for preparing the annual draft budget is the armed forces plan which consists of a mid-term part (5 years) and a long-term part (10 additional years).
 - (a) The "Defense Policy Guidelines" issued by the MOD assess the current and foreseeable future political, economic, and military strategic situation.
 - (b) The "Military Strategic Goals," based on the defense policy guidelines, include the framework and goals for the development of concepts.
 - (c) The "Bundeswehr Concept" prioritizes tasks needed to accomplish the military strategic concepts.
 - (d) The "Planning Guideline," a document affecting the transition from the goal setting to the planning phase, initiates a process of translating the threat oriented statement of need to the more concrete terms of calculable feasibility.
 - (e) The "Planning Proposals" include data for a period of up to 15 years on such things as research and development (R&D) projects.
 - (f) The planning proposals of the services are examined for feasibility and combined into the "Bundeswehr Plan." The Bundeswehr Plan documents the outcome of the planning phase. Further, it is also used as the basis to prepare the annual budget estimate.
- (2) The MOD budget proceeds along the following steps:
 - (a) The MOD prepares the Bundeswehr Plan, based on such things as the defense policy guidelines, military strategic goals, etc.

- (b) The Ministry of Finance distributes budget guidelines to the various departments/Ministries which determine the amount of financial resources available. (December)
- (c) The MODs armaments department conducts "programme negotiations" with both users and providers in which all development and procurement projects are examined for their technological, financial, and economic feasibility. Proceeding from these draft estimates, a "consolidated budget estimate" is prepared for the Ministry's budget division. (December to March)

(Note: Since the Chief of Staff for each service is accountable for the operational capability of his service, each of the services will establish its own priorities for its major weapon systems. However, if a large weapon system is acquired or something unforeseen takes place, the Chief of Staff, federal armed forces, will attempt to negotiate with the Chiefs of Staff for the individual services to realign their priorities.)

- (d) The MOD budget division prepares the draft budget. (March and April)
- (e) The Ministry of Finance integrates the draft defense budget into the total federal draft budget. Coordination also takes place in the federal cabinet. (April to July)
- (f) The overall draft budget is forwarded to the Parliament after approval by the cabinet. (July)
- (g) The Parliament has the "first reading" on the MOD draft budget. At the same time, the Defense Committee screens and evaluates individual projects supported by the draft budget. (July to November)
- (h) During the preceding step, decisions by the Defense Committee may result in changes to the draft budget. As a result, a revised draft budget will be presented

for the "Second" and "Third" readings in Parliament. (November to December)

- (i) After the final vote in Parliament, the Chancellor and the President of the Federal Republic sign the budget into law. (December)
- (j) The budget becomes effective the first of January. (January)
- (3) According to a MOD official, the MOD budget is completed in a 24-month time span which includes:
 - (a) Development of the Bundeswehr Plan.
 - (b) Development of the budget.
- (4) The MOD can carry funds over from 1 year to the next on a case-by-case basis.

--Defense budget

- (1) The MOD budget for 1985 was 49 billion DMs, which was a 2.4 percent increase over the preceding year.

Functional analysis of the defense budget

	<u>Billion DM</u>
(a) Personnel expenses	20.3
(b) Maintenance & operations	4.3
(c) Other operating expenses	7.1
(d) R&D (plus testing)	2.5
(e) Military procurements	12.1
(f) Military construction	2.1
(g) Other investments	<u>.6</u>
Total	<u>49.0</u>

- (2) According to a MOD official, the type of procurement expenditures include:

	<u>Percent</u>
(a) Federal Republic of Germany	15
(b) Collaborative	70
(c) Procurement from foreign sources	<u>15</u>
Total	<u>100</u>

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(B) MOD

--The MOD consists of the following elements:

- (1) The Minister, the Parliamentary State Secretary, and two state secretaries form the Executive Body of the MOD.
 - (a) The Minister is responsible for both the military and civilian elements of the MOD.
 - (b) The Parliamentary State Secretary acts as representative of the MOD in Parliament and in the cabinet. The Parliamentary State Secretary is responsible for the military sector in the MOD.
 - (c) The State Secretaries are responsible for administrative matters, defense equipment, Bundeswehr planning, logistics, and data processing.
- (2) The Parliamentary State Secretary is also responsible for the federal armed forces staff which consists of the following:
 - (a) Chief of Staff Federal Armed Forces.
 - (b) Chief of Staff-Army.
 - (c) Chief of Staff-Air Force.
 - (d) Chief of Staff-Navy.
 - (e) Federal Armed Forces Surgeon General.

(Note: The Federal Armed Forces Staff ministerial level--provides direction to the individual services--implementation level.
- (3) The State Secretary for Administration is assisted by five independent divisions.
 - (a) Personnel division.
 - (b) Budget division.
 - (c) Administrative and legal affairs division.

(d) Quartering, real estate, and construction division.

(e) Social services division.

(4) The State Secretary for Armaments is responsible for the armaments division which is concerned with the development and procurement of armaments material.

(Note: The armaments division--ministerial level--provides direction to the Federal Office for Military Technology and Procurement (BWB)--implementation level.)

--The MOD weapon system acquisition process is characterized as being centralized. This centralization consists of a ministerial/implementation element as well as a military/civilian element.

--The military service staff is involved in the entire acquisition process by determining the military requirements, providing logistic support, performing operational testing, and maintaining the weapon systems. The service provides the system manager who is the leader of the Systems Manager's Working Group.

--The armaments division and BWB are responsible for system definition, development, test and evaluation, production, and procurement.

--The MOD weapon system acquisition process is governed by the principle of civilian control and continuous interaction between the civilian and military elements involved in weapon systems acquisition.

--As of March 1985, the MOD (ministerial level) had a total of 5,285 personnel. The Federal Armed Forces Staff had 1,547 personnel (259 civilians and 1,288 military personnel) while the armaments division had 419 personnel (399 civilians and 20 military personnel). At the implementation level, the BWB had a staff of 18,000 personnel.

--According to a MOD official, the MOD has five personnel that are considered political appointees:

- (1) MOD.
- (2) Parliamentary State Secretary.
- (3) State Secretary - Administration.
- (4) State Secretary - Armaments.
- (5) State Secretary of security policy.

--The MOD uses the Systems Manager's Working Group which maintains a dialogue throughout the acquisition process.

The Systems Manager's Working Group brings together the needs, skills, and experiences of the service staff level, the service user, the armaments division level, and the BWB procurement experts. The Systems Manager's Working Group consists of the following personnel:

--Ministerial level

--The chief of staff of the proponent service will select the system manager from the individual service staff's armaments section. He is assisted by the logistics, planning, and operations sections.

--The project official in the armament division is selected from one of the five technical sections. He is assisted by other engineers, contract specialists, and technicians in the remaining technical sections.

--Implementation level

--The BWB will select the project manager from the project section.

--The individual service (user) will provide a project officer to represent the user's viewpoint.

- After the Systems Manager's Working Group has prepared the phase documents, these documents will be approved by the Chief of Staff Federal Armed Forces and the Head, Armaments Division.
- Coordination and interaction between the military and civilian elements is maintained by means of the Systems Manager's Working Group and the annual planning process which includes the development of the annual Bundeswehr Plan and the budget.
- The military services are responsible for determining the operational requirement, providing logistic support, conducting operational testing, and maintaining the weapon systems.
- The BWB is responsible for all contracting in the MOD dealing with weapon system acquisitions.
 - (1) Contracting officers are assigned to the project manager and are responsible for securing contracts with industry for the concept, definition, development, and procurement of the weapon systems.
 - (2) In the event that sole-source contracts are inevitable, the profit rate allowed is calculated by using the capital invested and frequency of turnover in the defense material. As such, the profit rate allowed can be as low as 2.5 percent or as high as about 11 percent.
- Initial cost estimates are developed by the BWB project manager of the Systems Manager's Working Group during the concept and definition phases. These cost estimates, based largely on input from the contractors, are continuously updated and verified throughout the acquisition process.
 - (1) The Systems Manager's Working Group reviews and revises cost estimates at the completion of each phase of the acquisition process.

- (2) Any real cost growth of 15 percent or more must be reported to the executive body of the MOD. Furthermore, because the MOD's budget is fixed, any cost growth in one project must be offset by reprogramming funds from other projects.
- (3) During the entire acquisition process, the contractor is also required to develop cost estimates. These estimates are reviewed by the BWB as well as other organizations for accuracy.

--The MOD's armaments division is responsible for all research during the weapon system acquisition process. During 1985, the MOD spent 2.5 billion DM for R&D which also includes testing. Normally, R&D is contracted out to industry.

(Note: According to a MOD official, the BWB may become more involved with research in the future.)

--The Systems Manager's Working Group is responsible for ensuring that all of the requirements of the development phase are met before the project is approved for production. The decision to enter production must be approved by the Chief of Staff, head of the armaments division and state secretary, and is based on assurances that the system meets the user's in-service requirements and BWB's testing specifications. Although design is frozen at the completion of the development phase, subsequent modifications are inevitable. Therefore, there is generally some concurrency of development and production.

(C) Industrial base

--A paper entitled, The German Systems Acquisition Process and Comparative U.S. Aspects, stated the following:

- (1) The MOD believes that once the services and the engineers and contracts people of the BWB have completed their work, industry should be allowed to develop the weapon system.

- (2) The MOD likes to place a contract with one firm, along with the total responsibility for all sub-contractors, government-furnished equipment, and for the performance data specified in the contract.
 - (3) The MOD, however, will control the prime contractor through all phases of the acquisition process. The BWB project manager and quality assurance inspectors will monitor the activities of the contractor.
- According to a MOD official, to the extent possible, the prime contractors are selected based on competition. Generally, there are two to six contractors in each weapon system area.
- According to MOD officials, the most important contractors for the major weapon systems in the Federal Republic of Germany include:
- (1) Ships
 - HDW, Hamburg n. Kiel.
 - Bremer Vulkan, Bremen.
 - Thyssen Nordseewerke, Emden.
 - Blohm & Voss, Hamburg.
 - AEG, Hamburg.
 - MBB, Bremen.
 - (2) Aircraft
 - MBB, Munich.
 - Dornier, Friedrichshafen.
 - (3) Engines
 - MTU, Munich.
 - KHD, Luftfahrttechnik.
 - (4) Tanks
 - Krauss - Maffei, Munich.
 - Krupp Mak, Kiel.
 - Thyssen Henschel, Kassel.
 - Wegmann, Kassel.
 - (5) Ammunition
 - Rheinmetall, Dusseldorf.
 - Diehl, Nurnberg.
 - Heckler & Koch, Oberndorf.
 - Dynamit Nobel, Troesdorf.
- According to a MOD official, the prime contractors and subcontractors share the following responsibilities:

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- (1) Concept phase--As a rule, concept studies are prepared by institutes and industrial enterprises on behalf of the MOD.
- (2) Definition phase--A firm will normally be selected to perform definition studies as well as develop the weapon system during the development phase.
- (3) Development phase--The contractor is responsible for all aspects of the development phase.
- (4) Testing--The contractor is responsible for shop trials to evaluate the result of the development activities as far as technology and economics are concerned.
- (5) Procurement--Procurement contracts must stipulate the contractor's obligations regarding quality control.

II. ACQUISITION PROCESS

- (A) Definition of a weapon system--The MOD does not use a monetary value to designate major or minor weapon systems. Instead, a project may be designated as a major weapon system if it is a complex program, entails technology advancements, large monetary outlays or involves a cooperative effort with other countries.

Phase documents--A phase document which provides for a performance evaluation is prepared at the end of each phase. During the creation of the phase document, it is ascertained whether an acceptable relation exists between required performance and required cost. (Go/no go decision.)

- (B) Preconcept phase

--The first phase of the project life cycle covers the period from the emergence of an idea for a project to the initial formal statement of an operational need.

--Permanent mixed study groups in the MOD are tasked with developing, for specific tactical fields, tentative conceptual approaches to countering an existing threat, or meeting specific needs.

- Study groups are chaired by a representative of one of the service staffs and are composed of representatives of the various specialized agencies, especially from the armaments division.
- The study group will develop the general staff target which defines the requirements that military hardware must meet in order to fulfill given missions.
- The study group will decide whether the project should be a "weapon system" or "equipment."
- At this stage, an evaluation is made whether an acceptable item is available on the market and is technically ready for adoption. If the item is not available on the market, the MOD will develop the weapon system.

(A go/no go decision is made at this point.)

(C) Concept Phase

- The second phase is used to offer solutions to the requirements set up in the general staff target which are acceptable in terms of technology, personnel, economy, and time.
- The Systems Manager's Working Group is established and develops a work breakdown structure for the weapon system.
- On the basis of the work breakdown structure, the BWB and subordinate service users prepare the implementation plans for the concept phase.
- As a rule, concept studies are prepared by institutes and industrial enterprises on behalf of the MOD. The final product is the selection of a concept that also makes allowances for options.
- On the basis of this concept, separate and coordinated work, time, and financial plans are compiled for the military, technical, economic, and infrastructure parts of the program. This information provides the basis for minimum and maximum targets for the weapon systems.
- When the staff requirement is prepared, it becomes the binding working basis for the definition phase. The time and cost schedules found in the staff requirement are incorporated into the planning proposals which are the basis of the force plan (Bundeswehr Plan).

(A go/no go decision is made at this point.)

(D) Definition phase

- The third phase is used to further define the concept. All risks involved in developing the material are kept to a minimum which also applies to the financial and time requirements.
- The service will perform studies of how to meet personnel requirements and carry out analyses in the fields of training, unit organization, logistics, and infrastructure.
- The armaments organization performs technical analyses to obtain information on critical components and risks involved in integrating existing modules.
- Based on the results of these studies, the project is defined in technical and financial terms, thus clearly designating the approach to development work. At this stage, the prime contractor is selected.

(Note: According to a MOD official, a prime contractor is theoretically selected at the beginning of development and at the beginning of production. Practically, the prime contractor selected for development will also produce the weapon system.)

- The final specifications at the end of this phase contain comprehensive data on design/engineering, including performance data, trade-offs (acceptable with regard to technology/time/cost, or with regard to reliability by modifying the performance profile), shop trials, technical evaluation trials, and user trials.
- The updated time and cost schedules are incorporated in the program proposals for medium-term planning. (Military/Technical/Financial Requirement Document.)

(A go/no go decision is made at this point.)

(E) Development Phase

- The fourth phase covers all activities from preparing and implementing the development contract to approval of the hardware for fielding.

- The BWB prepares the development contract and awards it to a contractor. The statement of work is based on the final specifications established during the definition phase.
- The contractor performs shop trials to ensure the provisions of the contract are fulfilled while the BWB performs technical evaluation trials to determine the technical capability. The BWB completes the promulgation of functional readiness and operational safety if testing is successful.
- The contractor develops prototypes for the user trials.
- If possible, development and operational testing is to be done concurrently.
 - (1) The user trials take place under field conditions that are as realistic as possible. The criteria are the tactical mission, the military requirement, and maintainability. The user trials lead to the statement of field operability.
 - (2) The BWB will then confirm that the requirements of the definition phase have been met.
- This phase concludes with the approval for production document which confirms that the weapon system has been manufactured in keeping with the purchaser's specifications and is ready to be introduced into service.

The BWB and user confirm that the trials have not only attested to the functional readiness and operational safety, but also to the capability of the product to undergo continuous operation and large-scale production.

(Configuration control is frozen.)

(A go/no go decision is made at this point.)

(F) Procurement Phase

- The fifth phase covers all measures taken to initiate and carry out production and to transfer the weapon system to the user.
- When complex weapons are involved, the preparatory measures for procurement are initiated in the development phase.

- Design changes will only be authorized when they are necessary for reason of safety, and are then subject to a formal modification procedure.
- It is essential during the procurement phase to ensure that logistical support and maintainability have been dealt with before delivery of the first production unit.
- A final report must be compiled, in which the progress and the implementation of the project is recorded together with the deficiencies recognized and experience gained.

(G) In-Service Phase

- The sixth phase is performed by the user which is oriented towards maintaining or restoring full serviceability of the weapon system. The armaments division, however, does perform certain specific technical and economic tasks.
- Maintenance levels are established which relate to the prospective maintenance work and the necessary repair parts related to specific weapon systems.
- Maintenance and repair work by private industry is usually carried out on the basis of master contracts awarded by the BWB.

(H) Cost, Schedule, and Performance

- The MOD did not have information readily available on cost, schedule, and performance regarding its major weapon systems.
- In 1971, the basic directive on the reorganization of defense production and procurement established the major weapon system acquisition process used by the MOD. The basic directive established:
 - (1) The definition of a project as to whether it is a "weapon system" or "equipment."
 - (2) The Systems Manager's Working Group maintains a dialogue between military and civilian personnel.
 - (3) The phases of the acquisition process and the associated phase documents.
- The MOD fielded 31 weapon systems over the past 10 years.

MAJOR WEAPON SYSTEM ACQUISITION PROCESSOF ISRAELI. ORGANIZATIONAL ASPECTS

(A) Oversight and funding

--Legislative participation

- (1) Knesset
- (2) Joint Committee of the Defense and Foreign Affairs Committee and Finance Committee (Subcommittee for Defense Budget)

--Legislative oversight and control

- (1) According to Israeli Ministry of Defense (MOD) officials, the Knesset generally approves the MOD budget with relatively few changes as part of the overall government budget.
- (2) The Subcommittee for Defense Budget evaluates the major weapon systems proposed by the MOD. Normally, the Subcommittee for Defense Budget is well aware of these programs and is only concerned about major changes to these programs.
- (3) With respect to the domestic budget, the MOD must get approval from the Knesset for any reprogramming changes that exceed \$200,000.
- (4) With respect to the foreign budget, the MOD can make changes to the purchases of weapon systems within the total sum of the funds appropriated by the United States.

--Budget process

- (1) The MOD uses a long-range defense plan covering 10 years which evaluates the enemy's capabilities and provides for a threat assessment. The long-range 10-year plan consists of a 5-year detailed plan and 5-year general plan.
- (2) According to MOD officials, the plan changes frequently based on unforeseen occurrences or frequent extreme budget cuts.

- (3) The MOD budget proceeds along the following steps:
- (a) General guidelines established by Planning Branch, Israeli Defense Force (IDF). (May)
 - (b) Services prepare plans based on the general guidelines. (June)
 - (c) Planning Branch, IDF integrates services' budget proposals. (July to Oct.)
 - (d) Chief of Staff IDF approves the budget. (Dec.)
 - (e) Planning Branch, IDF completes the integrated program. (Dec. to Jan.) (Budget limitations are identified at this time.)
 - (f) The General Staff MOD approves the budget. (Feb.) (The General Staff consists of military personnel plus the Director of Defense Research and Development (R&D) and Director of the Budget Department.)
 - (g) MOD budget sent to Knesset (March) as part of the total budget.
 - (h) Time span--12 months.

--Defense budget

- (1) The fiscal year 1985 MOD budget is about \$4 billion. (domestic budget = \$2.6 billion; United States aid = \$1.4 billion).
- (2) The MOD domestic budget can change dramatically from one year to the next (i.e., 25 percent).
- (3) The domestic fiscal year 1985 budget allocated to the services as follows:

	<u>Percent</u>
(a) Air Force	38
(b) Navy	6
(c) Ground Force	51
(d) Intelligence & others	<u>5</u>
Total	<u>100</u>

(Note: The actual percentage of funds allocated to the services can change each year.)

(B) MOD

--MOD control over acquisition process

- (1) According to MOD officials, the major weapon system acquisition program is more centralized than the United States system. They noted the MOD currently has 10 major weapon systems that are acquired through the domestic budget.
- (2) According to a MOD official, the relatively small size of Israel simplifies the major weapon system acquisition process.
- (3) The MOD will generally attempt to
 - (a) provide answers for special operational needs for the IDF,
 - (b) provide quick solutions for urgent needs,
 - (c) exploit technological surprise factors in the battlefield,
 - (d) foster the technological capability of the State of Israel,
 - (e) purchase existing major weapon systems from foreign countries, and
 - (f) develop those systems that currently do not exist.
- (4) The Chief of the General Staff approves the need and operational requirements for the major weapon system acquisitions as determined by the services.
- (5) The MOD's Director General attempts to acquire the major weapon systems to meet the operational requirements. The Directorate of Defense R&D develops new systems while the Directorate of Procurement and Production procures systems developed by other countries.

--Civilian effect on the acquisition process--(2,500 personnel.)

- (1) According to a MOD official, the civilian organization of the MOD is controlled by the Director General who reports to the MOD.
- (2) The Director General is supported by the following:
 - (a) Directorate of Defense R&D - 170 personnel
(civilians = 55%)
 - (b) Directorate of Procurement and Production
- 470 personnel
(civilians = 90%)
 - (c) Finance department - 300 personnel
 - (d) Budget department - 100 personnel

(Note: The total number of personnel working for the MOD does not include the government-owned companies.)

--Role of the services

- (1) The Chief of the General Staff or Deputy approves the major weapon systems identified by the individual services.
 - (a) Air Force.
 - (b) Navy.
 - (c) Intelligence.
 - (d) Ground Corps Command.
- (2) Each of the services has an Operational Requirements Division. (The services determine their own priorities based on specific budget allocations to the services.)
- (3) The services share the cost of development with the Directorate of Defense R&D.
- (4) The Air Force, Navy, and intelligence services have their own project managers to monitor the weapon systems.
- (5) The Grounds Corps Command uses a developmental committee to define the technical specifications for the major weapon systems.

- (6) According to a MOD official, the services are generally responsible for development and operational testing. If possible, developmental and operational testing are conducted concurrently.

--Program management

- (1) The MOD does not have a large number of program managers because there are few major weapon system acquisitions.
- (2) The Directorate of Defense R&D provides a program manager for a major weapon system. In one unique case, the program management project was assigned to the services. (i.e. Ordnance Corps--Merkava tank)

--A major weapon system uses the program management system used by the United States.

--A minor weapon system is administered by the Chief of the Program Staff from the Directorate of Defense R&D.

--Cost estimating

- (1) The MOD's economic advisor evaluates the general impact of the major weapon system acquisition programs. If large enough, the economic advisor develops cost models for the program management. (life-cycle costs)
- (2) The Directorate of Defense R&D also evaluates the cost estimates of the prime contractors for smaller weapon systems. The Directorate of Defense (R&D) contracts for development and prototypes by using a ceiling price or fixed-price incentive contract.
- (3) The Directorate of Production and Production uses a fixed-price contract for most weapon systems that have been developed.

--Major weapon system contracts normally have a negotiated ceiling price.

--Minor weapon systems are normally acquired under a bid process.

--R&D

- (1) The Directorate of Defense R&D conducts research.
- (2) The universities and science institutes conduct a small amount of basic research under MOD contracts.
- (3) The services fund exploratory and developmental research.
- (4) The production centers and government-owned companies conduct basic research.
- (5) The private companies conduct exploratory and developmental research using their own funds.

(C) Industrial base

--According to a MOD official, the MOD relies on different types of companies.

- (1) The government-owned production centers:

--Rafael conducts developmental research regarding missiles and other areas.

--IMI conducts limited developmental research on munitions. IMI is more concerned with production.

- (2) The government-owned companies have a board of directors and can raise funds in the capital market if approved by the Israeli government.
- (3) The mixed companies are owned by the MOD and private sources.

--The MOD will own a portion of the private companies. For example, the MOD may own 60 percent while the private source may own 40 percent.

--The MOD plans to pull out of all private companies.

--State owned versus private: According to a MOD official, the major weapon system programs are generally awarded to the production centers or government-owned companies.

--Competition

- (1) According to a MOD official, competition does not exist for the major weapon systems because there are few major defense companies.
- (2) Limited competition exists for the sub-assemblies used in the major weapon system acquisition programs.
- (3) The MOD either develops or purchases its major weapon systems from another foreign country.

--The contractor is selected to develop and produce the major weapon system and prototypes are generally not used for the selection.

--The MOD relies on 10 companies to develop its major weapon system acquisition programs. The Directorate of Defense R&D selects the prime contractor.

--Contractor responsibilities

- (1) The contractor provides input to the development assignment and technical specifications.
- (2) The contractor works closely with the following:

--Service project officer.

--Defense R&D program manager, Chief of the Program Staff, or coordinator.

II. ACQUISITION PROCESS

--Definition of a major weapon system: The MOD uses a monetary level to designate a major weapon system. A major weapon system normally exceeds \$10 million in R&D costs and \$40 million in procurement costs.

--System definition: Each of the services, Air Force, Navy, Intelligence, and Ground Corps Command have an operations requirement division which defines the operational requirements.

--The Chief of Staff IDF or Deputy decides to acquire the major weapon system based on the operational requirement and system analysis.

--Cost, schedule, and performance: The MOD did not provide information regarding the cost, schedule and performance of its major weapon systems. MOD officials identified the following systems:

- (1) Kfir combat aircraft.
- (2) C-2 follow-on.
- (3) Merkava tank.
- (4) Shafrir air-to-air missile.
- (5) Naval patrol boat.
- (6) Gabriel missile.

SYSTEM ACQUISITION IN THE SOVIET UNIONINTRODUCTION

In a number of respects the defenses of the Soviet Union, our superpower rival, are the most interesting to compare to the United States. Its governing structure, defense organization, military missions, and design philosophy are markedly different from those of the United States and its allies. Some in the West belittle Soviet weapons. Nonetheless, the Soviet Union turns out some very respectable, technically advanced weapon systems, often at low cost. Vehicle by vehicle, pound for pound, some engineers claim, the performance of Soviet weapon systems are similar to those of the United States. (12/709, 711)*

The problem in studying Soviet ways is the extreme secrecy enveloping the Soviet defense establishment and all its complexity; a degree of military secrecy that hobbles communication and coordination within the country itself. For instance, there is little spillover of production technology to the civilian sector. (1/121) No critical journals or public debate exists on Soviet military affairs as in the United States and other western countries.

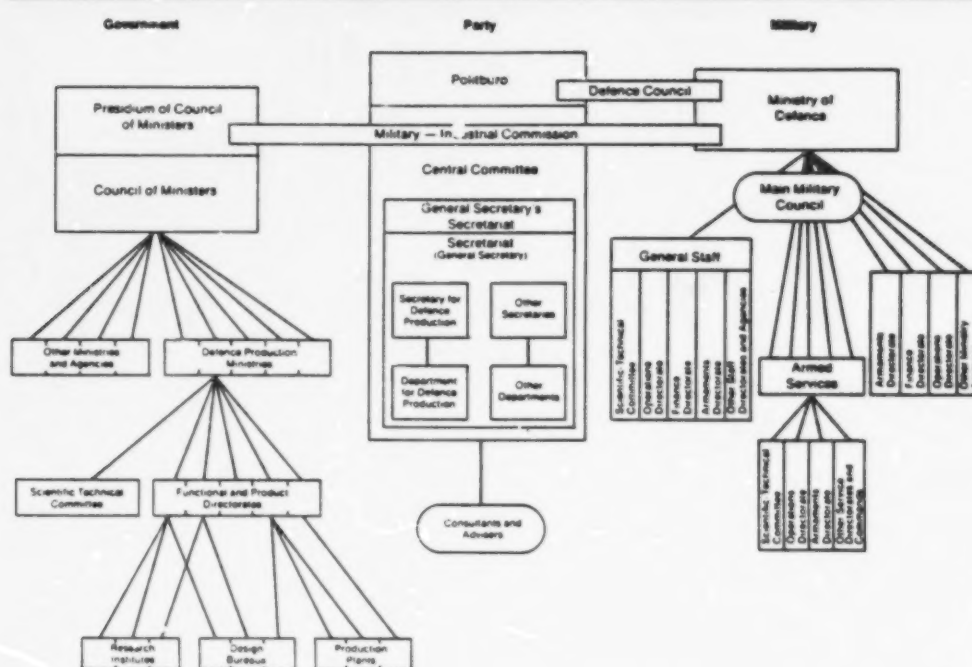
Most information on this side of the Iron Curtain is generally derived, from conjecture, intelligence insights, debriefing of Soviet emigres, and analysis of Soviet military equipment that comes into our hands. Some are contradictory, but excellent work has been done in fathoming the Soviet system. (See Selected Bibliography, pp. 87-90). We have relied greatly on these sources for this paper.

SOVIET LEADERSHIP

There are two governing structures in the Union of Soviet Socialist Republics both of which place great attention on defense. (See fig. 1). One is the Communist Party of the Soviet Union whose influence permeates the military and all other aspects of Soviet life. The other is the nominal government which rules through the Presidium of Ministers and the Council of Ministers. Military requirements get first priority in all these organizations. The predominance of defense in the state run Soviet economy is reflected in its share of the gross national product currently estimated at about 20 percent; in the United States the corresponding figure is 6 percent. (20/1)

*"12" is the number of the source document (see selected Bibliography in Appendix V-A). "709" and "711" are the relevant page numbers. This is the reference method throughout.

Figure 1 Principal Organization in Soviet Weapons Procurement



Source: 5/7

THE COMMUNIST PARTY: THE POLITBURO

At the top of the Communist Party is the Politburo, an inner circle of about two dozen officials from the Party's Central Committee. Only occasionally does it include a military representative; politicians are clearly in control but military matters are so compartmentalized that informed criticism may be lacking. The Politburo has final authority in all national decisions. It formulates national goals and plans for the government to carry out. In defense matters, it oversees plans, budgets, large nonrecurring expenditures, new weapon programs, and even system quantities. From time to time the Politburo has stimulated new technological approaches in weapon systems. Most of the top military officers are members of the Central Committee.

The Party Secretariat

This 10 member Secretariat of the Party's Central Committee is headed by the General Secretary of the Party (Mikhail S. Gorbachev), the most powerful post in the Soviet Union. The Secretariat parallels the American National Security Council in that it formulates decision papers for the Politburo. Among the departments is a Secretariat for Defense Production with its subordinate Department for Defense Production numbering about 1,000 people. According to one observer, the defense production staff engages in investigations, analyses, and political matters much like the staff of a U.S. congressional defense committee monitoring possible departures from congressional policy. (5/11, 12)

Communist Party influence

Practically all defense executives in the Soviet Union are party members. The MOD on the government side is a party man (and a military officer). About two dozen top military officers are on the Central Committee. All upper ranked officers are party members and about 90 percent of the lower ranked ones belong to the party, or the Komosol, the party youth group. (9/46) In addition, the party and government are linked by parallel functioning, exchange of officials, transfer from one structure to the other and long acquaintance. If there is a "military industrial complex" in the United States, it has been said, there is a "Party Military Industrial Complex" in the Soviet Union. (1/107)

One advantage of the Soviet weapon acquisition process is the extended tenure--unlike the United States experience--of those who manage and work in the defense establishment. Some Soviet chief designers of weapon systems have been on the job for 25 years or more dealing with the same class of weapons. (14/461)

The Defense Council

This panel or "Soviet" is composed of certain Politburo members and possibly top military officers. Chaired by the General Secretary of the Party, the Council deals with broad state/military issues such as strategy, doctrine, and weapon system acquisition. In wartime, this Council could be the body to marshal economic, political, and military efforts.

To provide expert advice and information, there are the Institution of Advisors to the Defense Council and the Institution of Permanent Consultants to the Council. The Advisors provide broad perspectives on military and foreign affairs. The President of the Academy of Sciences is a member. The lower ranked permanent consultants cover detailed military planning. Both groups are sources of information on the latest military technology. (19/16)

The State Committee for Science and Technology monitors the acquisition and assimilation of technology intelligence from the West. It is estimated, for instance, that by obtaining American military documentation the Soviets saved 5 years in developing their latest generation of fighter aircraft. (26/1)

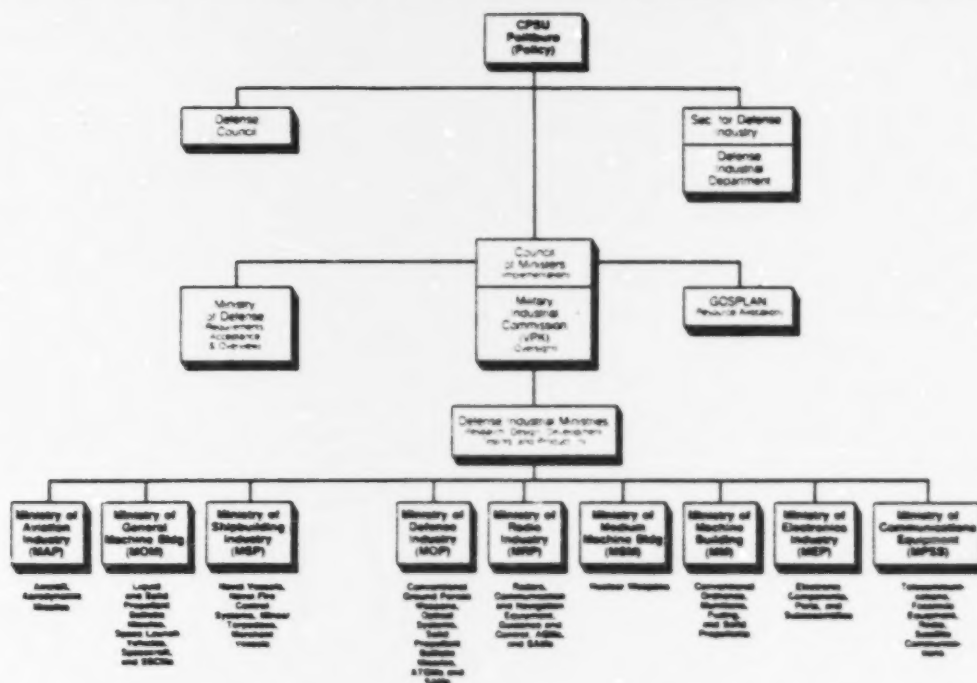
THE LEGISLATURE OF THE SOVIET UNION

The Supreme Soviet consists of two houses, one elected on the basis of population with 767 members, and the other consisting of 750 members representing territorial units. They meet for 3 or 4 days every 2 years. (27/1181) Unlike the U.S. Congress, the Supreme Soviet has no critical role in defense affairs; it mostly ratifies decisions made.

THE GOVERNMENT OF THE SOVIET UNION

The Chairman of the Council of Ministers is equivalent to prime minister, although lacking the power of counterparts in some other countries. Under party direction, the Council consists of about 100 ministers who supervise the production of all goods and services in the Soviet Union. There are four upper level bodies of interest, a Presidium of the Council, MOD, the Military-Industrial Commission, which is an implementing function, and Gosplan (the national comprehensive planning agency for state-wide planning and allocation of resources). There are nine defense industrial ministries, each in charge of a particular military product line. (See fig. 2.) Salaries in the defense establishment are said to be 20 to 25 percent more than civilian work. Defense industry wages are higher too. (1/114)

Figure 2 Organization of the Soviet National System for Military System Development



Source: 10/34

THE DEFENSE APPARATUS: THE MILITARY INDUSTRIAL COMMISSION

An implementing, coordinating trouble-shooting group, this Commission sees to it that military priorities (always first in the Soviet Union) are obeyed, bottlenecks are cleared, and scarce materials are made available for military equipment. It is chaired by the Deputy Chairman for Defense Affairs. (9/50) The Commission apparently is a working organization of the Council of Ministers. The Commission reviews new weapon proposals for technical feasibility, producibility, and scheduling. It is also a source of analysis and evaluation. Its draft decrees, said to be legally binding on all concerned, provide approval of new weapon systems and specify tasks, participants, financing, scheduling, and so on.

Although its organization chart is not published, the Commission is believed to be composed of representatives of the defense production ministries, Gosplan and staff of the (Party) Central Committee Secretariat. (26/1)

MOD

The MOD is guided by the Council of Ministers (see fig. 2). The defense minister, a military officer, is in charge of all military forces and defense activities. The next in command is the Chief of the General Staff, or the Warsaw Pact commander. Other deputy ministers of defense are the chiefs of the five armed services and a deputy minister for administration. The Minister has an advisory body called the Main Military Council. The Minister and the five service chiefs have similar staffs for armaments, operations, finance, scientific-technical affairs, and so forth. MOD personnel are mostly military; there are relatively few civilians employed. (5/16-18)

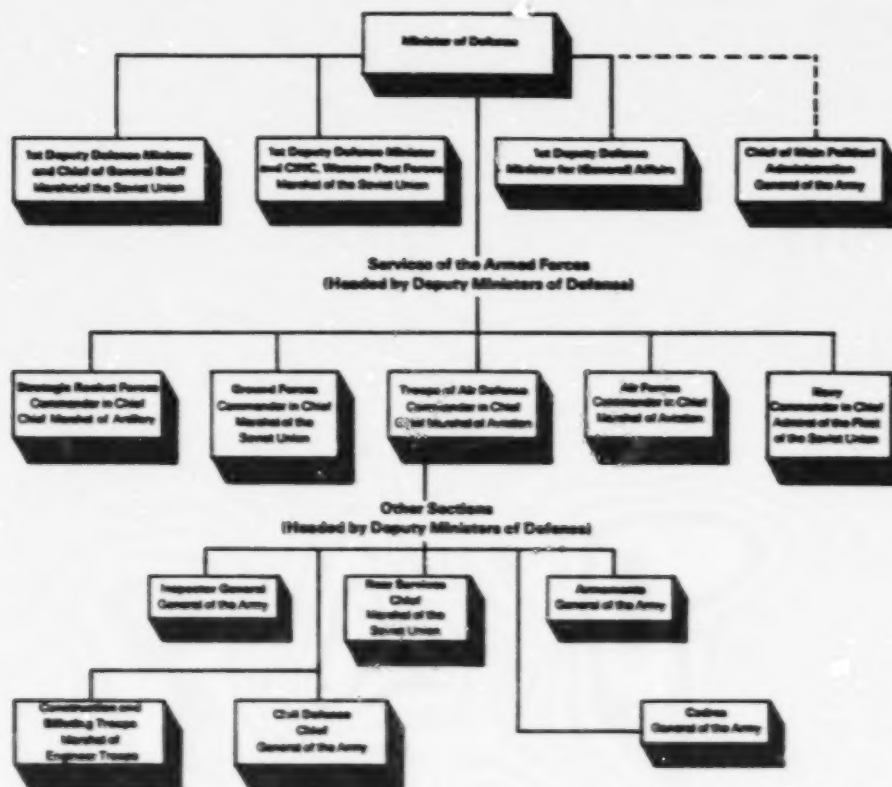
The Main Military Council

This is the administrative body in the MOD concerned with running military affairs, and also a source of proposed policies, alternatives and options for the Defense Council and the Politburo to consider. Membership consists of the Minister, First Deputy Chairman, the Deputy Chairmen (chiefs of the five services) and the head of the Main Political Administration. (See fig. 1.)

The Soviet Armed Services

There are five armed services: Strategic Rocket Forces, Ground Forces, National Air Defense, Air Force, and Navy. (See fig. 3.) Unlike the United States, there are few or no civilians in military development and policy positions. Strategy, doctrine, and force requirements are exclusively the province of military professionals. The services' armament directorates deal directly with the defense production ministries in establishing requirements, conducting tests, and observing progress in weapon system development and production. The service academies perform research in operations, system utilization, and capabilities. There is no extensive number of civilian defense analysts as in the United States. (11/277)

Figure 3 Member of the Main Military Council (Kollegiya) of the Ministry of Defense



Source: 2/105

Specially trained in system acquisition by their service academies, military officers are detailed to production plants, to see, for example, that requirements and design quality standards are met. They may also prepare independent cost estimates. The officers have veto power; they can shut down production and refuse to accept the product. If a monitoring officer lets questionable work get through, he may be severely punished. (5/19)

The General Staff

The Soviet General Staff resembles the Prussian model of a strong supra-military body exercising operational control over the armed forces. It is said to have enormous power and influence. Requirements are not issued here but all such proposals flow through this top military body. Conflicting service demands are settled here and recommendations are made to fit military needs to procurement goals and budgets. (5/17)

The General Staff has assumed a larger role in system acquisition to address increasing cost of systems, efficient choices among system proposals, and the need for more flexibility in development, that is, new, innovative technology. The General Staff is said to be getting more technical; the last two chiefs have been technically oriented rather than the field commanders as appointed in the past. Like other advanced nations, scientists are being recruited into the Soviet officer corps. (4/12)

Defense Production Ministries

Heading the nine ministries, the defense ministers report to a Deputy Chairman of the Council of Ministries. There is coordination by the Military-Industrial Commission, Gosplan, and the Party's Department of Defense Production. The defense ministries have the highest priorities for resources, and production contracts have the force of decrees or mandates. For all production ministries, central planning associated with the Soviet economy demands strict accomplishment of quotas, deadlines, and standardization edicts. Awards and penalties are laid on accordingly. (7/17, 13/20)

The ministries stand apart from one another in the same way perhaps as large competitive American corporations. In the Soviet Union, each ministry makes its own parts mainly to ensure reliable supply--even such items as rivets, bolts, tooling, instruments, rolled aluminum, and other diverse items. (19/26) Such "captive" or specialty activities have long been spun off by American manufacturers for efficiency's sake.

The defense ministries are internally departmentalized according to class of product or weapon system produced. Such departments or product directorates have their own research institutes, design bureaus, and production plants, again analogous to American companies, but with some interesting contrasts. According to a 1973 report (8/2), the Ministry of Aviation Industry included about 6 research institutes and 11 aircraft, helicopter and aerodynamic missile design bureaus, 5 engine design bureaus, and 30 to 40 production plants. There are about 50 major design bureaus devoted to major defense programs in the Soviet Union. Some 60 percent of the Soviet enterprises may be engaged in some kind of defense work. (1/123) Research institutes, design bureaus and production plants are independently administered and financed. Budgets and manpower are stable and unaffected by cyclical ups and downs. Still, engineer-analysts find evidence of a very uneven technical base. (14/456)

Research Institutes

Like American defense firms, the Soviet ministries employ scientists and engineers to do applied research on their product

lines. Unlike the freedom allowed United States research, the Soviet policies of conservatism, standardization, and quota accomplishment tend to restrict research to revising the technology in hand and improving manufacturing processes. Industry performs some basic research, however. The institutes provide an array of technical handbooks to guide design bureaus. Such instructions include manufacturing techniques.

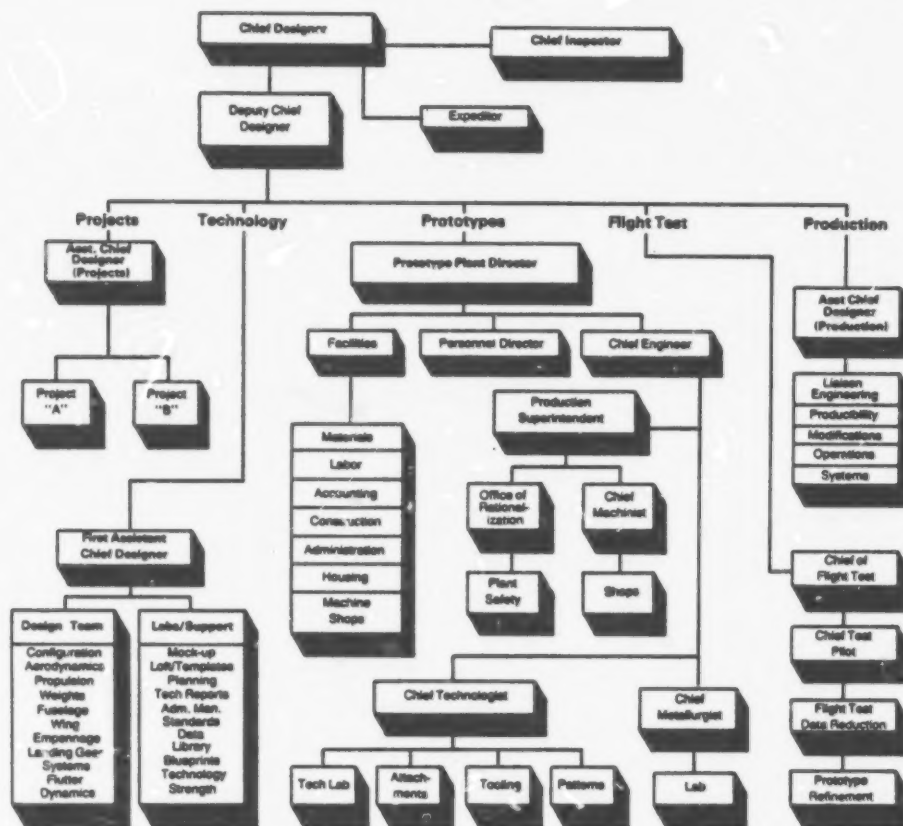
For more imaginative work, contracts are let to individual consultants, educational institutes and civil scientist centers for basic research, problem solving, and advice on new scientific paths. Some prototype building and testing may also be assigned to the research institutes but it is normally the province of design bureaus also in the same defense industrial ministries.

The Soviets are said to equal or lead the United States in some dozen advanced technologies such as high energy research. One Russian emigre scientist asserts, however, that the Soviets have generated no new ideas in military technology since World War II, but rather have adopted Western concepts. (1/107) Another observer remarks that the Soviets rarely field a new system before the United States. (19/38) There is other Western opinion that the Soviets have already reached technical parity in Europe in battle tanks, armored personnel carriers, fighting vehicles, artillery, and tactical aviation. (28/80)

Design bureaus

The main function of these bureaus is to design and develop new experimental systems and to upgrade existing ones as proven technology becomes available. American engineers discern a common style in Soviet design of ships, aircraft missiles, and vehicles. (14/405) Seldom is more than one new technology used in a new or upgraded system. Prototype building and rigorous testing is standard practice. Large design bureaus have their own prototyping shop and testing facilities. (See fig. 4.) Smaller bureaus may use prototype shops elsewhere. Decisions to build and test prototypes implies no automatic commitment to production. (8/29)

Figure 4 Experimental Design Bureau



Source: 17/29

Designers work within the constraints of highly detailed technical handbooks produced by various research organizations. The handbooks are the means of technology transfer in the Soviet Union. They also tell designers which (proven) components may be chosen, limitations on scarce materials, and appropriate manufacturing techniques. No unproven technology may be used unless absolutely necessary. (14/431)

The Soviet designer is required to use standard off-the-shelf components even if system performance is less than desired. His only leeway is in devising synergistic combinations of the parts available to him. American analysts of Soviet equipment have noted ingenious integrations of interchangeable, sometimes obsolete components. Soviet designers "think poor." (12/709, 712)

American system design teams in industry tend to form up for a new program and then dissolve when the work is over or significantly delayed. Their Soviet counterparts, however, stay together for years, which promotes design consistency and corporate memory. (14/465) For one thing, continuity in the Soviet Union is supported by the practice of funding design bureaus apart from specific programs, unlike the United States. Stable funding allows for other experimental work when system development is slack or delayed. Production is kept stable too by filling slack periods with civilian work. (11/282) Finally, the Soviet policy of full employment underwrites long tenure.

Production plants

Many aircraft, missiles, vehicles, and electronic devices are single-task or single-mission and designed to meet reasonable minimal military requirements, and no more. The system discourages the forcing of technology unless absolutely necessary. The rule of thumb is, "if it works don't change it." (14/448) Complexity avoidance accommodates no-frills manufacture, all-purpose tooling, low technology materials, many interchangeable components, labor intensive methods (such as hand assembly), crude finishing in non-critical areas, and long production runs. The output is technically undemanding, rugged equipment suitable for conscript armies (and third world countries). (14/436)

System design in the Soviet Union serves military doctrine, cost containment, and the national policy of full employment. Not too far down the road, however, is increasingly sophisticated technology, such as micro-electronics to challenge Soviet manufacturing. (14/443) United States engineer-analysts attribute Soviet lag in technology to limitations in manufacturing capability. (14/443) But our Department of Defense recently termed Soviet aluminum forging and fabrication as among the best in the world and in fabrication of thick plate titanium about 10 years ahead of the United States.

SYSTEM DESIGN PHILOSOPHY

Both Soviet and United States weapon designers must trade off among system performance, cost, and schedule. They can only

"get" by "giving" (12/711); there are no magic outcomes such as high performance, low cost, and quickly delivered equipment in one package. Like other countries, the Soviet Union has had its disappointments such as the Grifon, SA-5 and Galosh anti-ballistic missile systems, all of which failed to meet expectations. (7/23)

The United States generally prefers high performance with its larger cost and hence fewer numbers: technology is viewed as a multiplier of capabilities. The Soviets choose modest technology, low cost, and mass quantities. These are generalities, of course, but the core philosophies are there, rationally espoused by both sides.

"Comrades, make it simple, make it reliable, make it rugged, make it work."

This message, attributed to Mikhail Mil, the Soviet helicopter designer, (12/706) sums up his country's conservative objectives for most conventional weapons. (12/706) The attributes he mentions suit the Soviet armed forces, their warfare strategy, and technological industrial base. United States systems, of course, suit this country's views.

Simplicity, standardization, and incremental improvement are often evident in Soviet ships, vehicles, missiles, aircraft, and even civilian equipment. (One source advises that new Soviet ships are warranted for certain operating periods 14/435.) Designs are well within the state of the art, and performance goals are modest. Yet, the Soviets do develop technologically advanced systems when needed. Similarly, simplicity and standardization can be found in some United States systems.

Military doctrine

As in other countries, the Soviet view of successful warfare is implemented by control of the design and quantities of weapon systems. The Soviet emphasis is on short rather than protracted combat, mass forces and firepower, and, for the technical capability of conscript armies, relatively simple "soldier proof" weapons. (6/34) The American preference, again, is for economy of force and versatile, technically advanced systems to offset large quantities. Doctrine on both sides is affected by technology advances, and perspectives on combat effectiveness.

Design simplicity

According to United States engineers who have analyzed Soviet equipment, the Soviets design only to just what is required and no more. Unlike United States designers, the Soviets have seldom sought technological advancement in most weapon systems except through incremental changes. Simplicity is thus derived, the engineer analysts say, and not a first priority in itself. (14/448)

The Mig-25 aircraft, for instance, was originally designed for the sole task of high-altitude interception of enemy aircraft--without a look-down radar, high-turning rate or the heavy ordnance of multi-mission planes. (7/12, 13)

Uncomplicated designs maximize standardization opportunities, enhance reliability, cost less and reduce maintenance training and logistics. (14/426) Simplicity is found in most every product line. A Tumensky jet engine, for example, has 30 to 40 percent of the parts in similar American engines. (12/709) In another comparison of engines, the Soviet maintenance-hours per operating hour was better by a factor of 12. (6/38) The Soviet maintenance ratio for surface-to-air missiles was estimated to be two to three times better than the United States. The Soviet T-62 tank is estimated to cost one-third to one-half that of the United States M60A1 tank. (7/7) American analysts found the SA-6 missile power plant to be "... unbelievably simple and effective". (21/22)

On the other hand, dated technology such as vacuum tubes and hand wiring cost more. United States engineer analysts see Soviet systems becoming more technically complex but still simpler than the United States systems due in part they say to excellent design. (14/429)

Simplicity has its flaws as well as virtues. There is risk of stagnation and block obsolescence of the inventory due to western technology leaps. The Soviets cannot be content with their computer capability, for instance, said to lag the United States by 3 years in mainframe computers; and 15 years in software. (30/1) A similar lag has been noted in electronics. (14/452)

Table 1: United States and Soviet Design Practices

<u>Element of design</u>	<u>United States design practice</u>	<u>Soviet design practice</u>
Design philosophy	Design to maximize performance	Design to functional requirements
Growth philosophy	Advanced technologies Emphasis on growth potential	Low risk design Little growth potential
Reliability	Designed-in	Off-the-shelf components; proven technology
Maintainability	By modular replacement	By component replacement
Environment	Full environment consideration	Limited consideration
Human factors	Strong consideration	Functional consideration
Checkout	Emphasis on automatic checkout	Manual checkout
Modification program	Minor; new hardware to meet new requirements	Extensive modification programs

Source: 14/447

Standardization

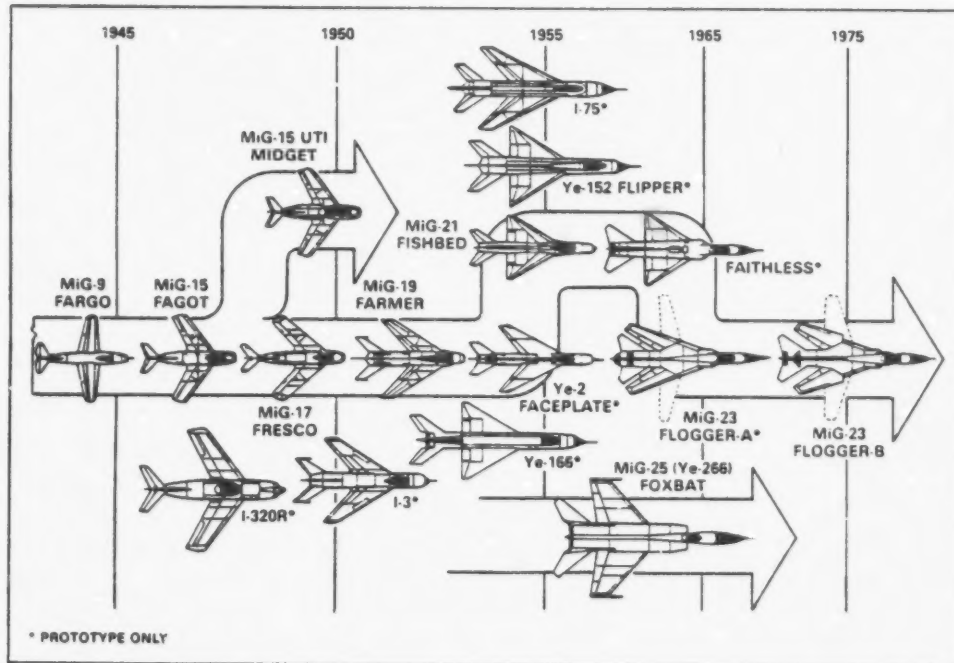
The use of common parts and components is widespread in Soviet equipment. Standardization amounts to a national policy. There are standardization monitors in research institutes, design bureaus, industrial ministries, and at the national level. The technical handbooks mentioned earlier enforce commonality. (8/4, 8)

The heavy attention given to standardization is shown in Soviet equipment. For instance, battle tanks such as the T-34 of World War II vintage and later the T-54, T-55, and T-62 have interchangeable road wheels, tracks, and transmissions. (14/431) The Mil-8 and Mil-24 helicopters have the same basic engine, transmission, and rotor. (14/436) The series of (Sukhoi) SU-7 aircraft used common design for canopies,

fuselage, empennage, and avionics. Soviet naval vessels use features common with merchant ships. The Mig-21 aircraft over a 20-year period was often updated (see fig. 5); an interesting point is that its new engines were refitted into earlier aircraft, thus keeping them in inventory. (14/431, 434) The later Mig-25 has been advanced as "unsurpassed in the ease of maintenance" and "a masterpiece in standardization." (6/32) (The asterisks in Fig. 5 denote prototypes.)

One drawback to standardization is that it inhibits the introduction of new equipment, and common components spread common vulnerabilities. (22/29) On the other hand, mothballed equipment can be reactivated without great logistic and training problems. It suits Soviet readiness to deploy systems in great quantity.

Figure 5 Chronology of Mig Aircraft



Source: (17/32)

In the United States, technological superiority has been the cornerstone of military policy. The American "all-new" weapon system idea eschews standardization in favor of specialized components. The military services are multipliers too, in their

resistance to merging their requirements and by insisting on their own variations. (22/ii) There is now a pre-planned product improvement program (P3I) in the United States which seeks timely replacement of obsolete components.

Design inheritance

Unlike weapon systems developed in the United States, again the Soviets rarely include more than one new technology at a time. (6/30, 31) Similarly cautious is their preference for step-by-step updating of weapons; "bloodlines" can be traced back through several generations. Inheritance or incremental change minimizes development risk and unforeseen costs. (5/23)

Figure 5 displays the evolutions of Mig fighter aircraft, including prototypes from the Mig-9 of World War II to the Mig-23 of the late 1970s. The Mig-21 Fishbed aircraft went through about a dozen versions from 1956 to 1973. One analyst links the Soviet T-62 battle tank to a distant ancestor, the American Christie design of the 1930s which the Soviets bought to analyze. (7/12)

Neither side is hard and fast on the matter. The American F-4 and A-4 aircraft, for instance, went through serial updating. The Soviets will occasionally develop an all-new system; the T-64 tank, for example, is a sharp departure from normal practice. (3/23)

Reliability and maintenance

By and large, the degree of sustainability and frequency of repair can be designed in. (14/452) Conservative, rugged designs, single-mission capability, and interchangeable proven components represent Soviet military doctrine. The Soviets expect their equipment to be short-lived, but deployment in mass, redundancy, and overlapping coverage are expected to compensate for inferior technology and battlefield losses. (14/465) "Quantity has a quality of its own" said one Soviet leader. (19/53) The United States and Soviet approaches are shown in table 2.

Table 2: United States and Soviet Approaches

<u>Factor</u>	<u>United States</u>	<u>Soviet Union</u>
Reliability	High, over a long period	Higher, during a shorter warranty period
Availability	High, after long, continuous peacetime use	Higher, after short limited peacetime use
Maintainability	Accessible	Limited accessibility
	Emphasis on repair at lowest organizational level possible	Emphasis on factory or depot maintenance
	Highly skilled manpower	Limited skilled manpower but very labor intensive
	Many special tools and test equipment	Simple tools and test equipment
	Extensive supply support	Highly selective supply support

Source: (14/440)

According to American engineer-analysts, Soviet equipment is very reliable for short (wartime) operating periods for which they are designed. Ships, tanks, and aircraft, because they are volumetrically "tight," offer limited access for subassembly exchange so they are repaired at the depot level. On the United States side, access is better planned, and extensive peacetime use is considered in the life cycle. In the United States, repair is done at the lowest possible organizational level. (14/442)

Vacuum tube electronics are still widely used in the Soviet Union. One advantage is that they can be tweaked or adjusted as performance falls off (adjustability is more common in Soviet equipment as they prefer mechanical devices rather than electronics). (14/424) Solid state components satisfy extended

peacetime use on the American side just as vacuum tubes serve Soviet requirements. It should be added that the Soviets use solid state devices when necessary. In the opinion of American engineer-analysts, the reliability of Soviet electronics so far ". . . is usually no better and at times very inferior to that of comparable U.S. components." (14/445, 450)

Redundancy

American and Soviet designers both employ redundancy to augment reliability but in different ways. For instance, within electronic devices, Americans provide redundancy to protect most vital points within a system itself. The Soviets tend to use optional modes of operation in their single-task systems. (14/452) The difference in deployment of surface-to-air defense systems has been summed up as follows by one military expert:

"Compare, for example, our antiaircraft forces with those of the Soviet Union. We equip all our ground forces with only one type of antiaircraft gun, one type of shoulder-fired antiaircraft missile, and just one type of full-size missile, which is supposed to intercept enemy aircraft in a wide band of altitudes, from the very low to the medium-high. The Russians, by contrast, have a wide variety of antiaircraft guns and missiles, each specialized in some way or other, with the low altitude, SAM-7's, SAM-8's, SAM-9's and SAM-10's, the high-altitude SAM-2's, and SAM-5's, and medium-altitude SAM-3's, SAM-4's, and SAM-6's." (23/22)

THE SOVIET ACQUISITION PROCESS

The Soviet design philosophy of simplicity, standardization, and inheritance discussed earlier minimizes uncertainty in development and costs, and limits problems in production. The Soviet acquisition process is a sequence of disciplined, risk-avoiding steps. (3/20) Tight deadlines are imposed. Approval of each step completed is marked by the joint signatures of system designers, government monitors, and military customers. Design agreements are legally binding. (14/461) Accountability is clear.

No production in Soviet plants begins until development and testing is finished. Concurrency (overlapping among development, testing, and production) is unheard of, except perhaps in crash programs. Cost overruns are not tolerated by the hierarchy; cost estimates are reportedly padded to guard against them. (5/25) In the United States, concurrency is frequent and cost estimates tend to be optimistic. Cost growth experienced by DOD is due to pushing technology and trying to manufacture unproven designs, according to one observer. (8/11)

In the United States, accountability for the system design is diffused; in the Soviet Union, the designer is prominently identified and held directly responsible for success or failure. The "carrot and the stick" are liberally expended in the Soviet Union. (8/10, 11)

On the civilian side of the Soviet economy, the customers have little choice of goods; they must take what they can get. On the military side, however, the customer is king, commanding the highest priority and choicest resources for defense needs. (11/23) As was mentioned earlier, officers specially trained in system acquisition are present in research institutes, design bureaus, and production plants to make sure that their subject systems meet military requirements. The military officer on the site is directly responsible for quality. He can shut down production lines and refuse the product.

Defining military requirements

As in other countries, the military services and user commands are the main proposers of new requirements. New technical opportunities may be presented by various research organizations and design bureaus. High level political figures seeking parity with the West have initiated catch-up programs such as jet aircraft and helicopters. Ad hoc teams may be formed to execute such crash developments outside the regular acquisition process. (4/31, 32) In the United States too, urgently needed systems have been similarly developed "off line." (8/15, 16)

Normally the service armaments directorate will convert the proposal to a draft Tactical Technical Instruction, which specifies a new system's rationale, estimated cost, and operational role. It is similar to the Required Operational Capability document in the United States. (13/15) When approved by the government and military elements, a scientific-technical commission reviews it for feasibility and producibility, possibilities for standardization, and so on. A research institute gets it next to do exploratory work. The documentation is then turned over to several design bureaus or teams to lay out, among other things, their own concept on paper. The scientific-technical commission then selects the most promising design or designs, acting as a source selection board. (8/6, 7)

Prototyping and testing

The next step is to convert the designers' concepts into semi-detailed drawings and then into working prototypes. These prototypes may embody different technological approaches and compete against one another especially in aircraft programs. (8/6, 7) General purpose machine tools are used. Prototype design and construction methods are regulated by handbooks. The

designer may be advised by assistant personnel such as test pilots and operational pilots. Manufacturing engineers will later prepare production drawings and advise on producibility. Drawings are revised based on test and evaluation results, as necessary. (13/14, 18) In any case, production does not begin until the prototype is proven. In the aircraft industry, about two prototypes are made for each aircraft reaching production. (8/7) Designers are required by law to evaluate alternative system concepts against such criteria as reliability, producibility and standardization. (14/454)

Prototypes undergo extensive laboratory and factory trials conducted by the design team, factory management and the military customer to check adherence to the Tactical Technical Instruction. The prototype may then be refined before "state trials" begin. State trials of the proposed system are conducted by the defense ministry concerned, the military industrial commission and the military customer. The trials usually take place on the latter's test grounds. (11/280) Depending on the outcome, the system will be accepted by the customer or sent back for modification. Once the prototype is approved, funds are provided for the entire full-scale development phase. (10/15) The series production decision considers several factors. The Defense Council or Politburo are the final arbiters.

The design team is not finished with the weapon system when it is turned over to the series production plant. A design team engineer accompanies the transfer and is on hand until production is completed. The designer has a large say in production and is held chiefly responsible for quality and schedule. (8/7, 14) Mistakes on his part can seriously disrupt important state planning.

Operational testing can be quite thorough and may continue through the lifetime of a system to (1) check out production line quality and (2) conduct troop testing. To evaluate delta wing and swept wing aircraft technology, 25 different kinds of Mig-21 aircraft were built for Soviet Air Force evaluation. The ultimate choice was not made until 100 preproduction test planes were produced and issued for troop testing. Several versions of the T-72 tank were tried out with the troops. A half dozen Yak-36 preproduction aircraft were also built and tested. (7/29) Since the Soviets evaluate weapon systems in their full tactical environment, field testing, and troop exercises are sometimes extensive. (6/40, 41)

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